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NATURAL HISTORY

THE OCEANS

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BIRD BANDING BY MAUNSELL S. CROSBY

The oceans unite all shores and bring the world more closely together. The expeditions of the American Museum have ranged over many seas and have enjoyed the aid and hospitality of maritime nations from the poles to the equator. To all of these the appreciation of the Museum is hereby extended.

JOURNAL OF THE AMERICAN MUSEUM OF NATURAL HISTORY
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From a painting by Courtenay Brandreth

A NEW KINGFISHER FROM THE TUAMOTUS

Todirhamphus gertrudæ, a hitherto undescribed kingfisher obtained during the Whitney Expedition at Niau Island of the Tuamotu Group, South Pacific Ocean. The bird at the right is an adult male, the other a female in not quite fully mature plumage; the reproduction is one-half natural size. The Polynesian kingfishers previously known to science are chiefly native to more or less mountainous islands. This species, however, inhabits a wooded atoll less than five miles in diameter, which encloses a mouthless lagoon.

The kingfisher has been named in honor of Gertrude Vanderbilt Whitney (Mrs. Harry Payne Whitney)

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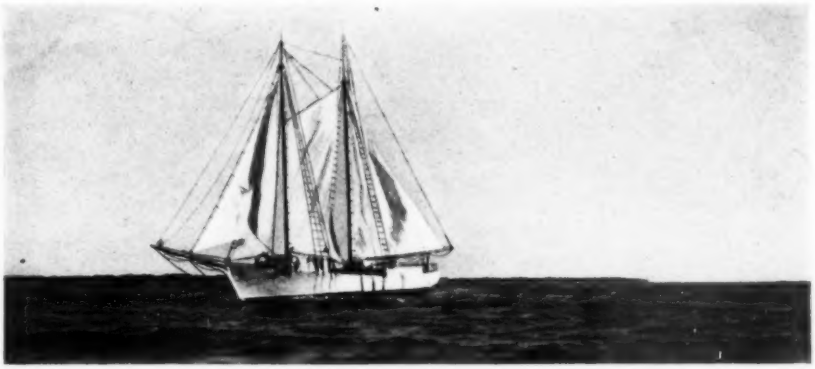


The "France" under motor power among coral islets of the Tuamotus

The Whitney South Sea Expedition

A SKETCH OF THE BIRD LIFE OF POLYNESIA

BY ROBERT CUSHMAN MURPHY

Assistant Director (Scientific Section), American Museum

THE PHOTOGRAPHS USED AS ILLUSTRATIONS OF THIS ARTICLE WERE TAKEN BY ROLLO H. BECK, LEADER OF THE WHITNEY SOUTH SEA EXPEDITION

EASTWARD from Australia and New Guinea, stretches the greatest assemblage of islands upon earth. The separate archipelagoes, which lie mostly between the outer borders of the tropics, are too varied to be considered as a unit and, like Gaul, are divided according to racial characteristics of the native peoples into three major parts, of which the easternmost is Polynesia or the domain of "Many Isles." Roughly speaking, this group comprises land areas of the Central Pacific Ocean which are situated east of a diagonal line connecting New Zealand with Hawaii.

Although all share the blood-stirring tradition of the true "South Seas," the Polynesian isles are by no means of one type; rather, they illustrate three or more stages in the birth or disintegration of oceanic land. Some, like certain of the Marquesas and Austral islands, are little more than bold rocks rising from profound depths. Others, such as Tahiti, are lofty, heavily forested, volcanic peaks, rimmed successively by narrow coastal shelves, sandy beaches, coral fringes, moatlike lagoons, and barrier reefs. Still others, like the majority of the Tuamotus, are low-lying bars and atolls, upon which mangroves and coconut palms make up the conspicuous vegetation. The several types occur, too, in hybrid stages, and they are sometimes further complicated by upthrusts from the sea bottom which cause such coral formations as Makatea and Mangareva of the Tuamotus, and Rurutu of the Australs, to resemble superficially the product of outpouring lava.

But whether a mere spit lying in perpetual jeopardy of engulfing waters, or a green and craggy mountain in the sea, each isle of Polynesia seems to have inherited some of the spell of Eden. "Few men who come to the islands leave them," said Stevenson, who exemplified his own belief; "they grow grey where they alighted. The palm shades and the trade-wind fans them till they die, perhaps cherishing

to the last the fancy of a visit home, which is rarely made, more rarely enjoyed, and yet more rarely repeated. No part of the world exerts the same attractive power upon the visitor."

THE SOUTH PACIFIC AS A FIELD FOR EXPLORATION

With the continual dwindling of unknown areas on the continents, the Pacific islands stand, in a sense, as the last rich field for scientific exploration. This does not mean that many islets, however insignificant, remain to be found and christened by adventurous voyagers. Most of them, indeed, have been pricked, generations ago, on well-worn charts, and have been named and renamed from two to ten times by seafarers of five centuries! Perhaps no tiny spot of land now exists the shores of which have not shown the ephemeral footprints of half a thousand freebooters, explorers, slavers, whalemen, and beach combers from the white man's world. But the greater part of whatever spoil or impressions these wanderers brought away has passed with them into oblivion.

True geographical science, in the words of Sir Archibald Geikie, is not a "chronicle of marvellous and often questionable adventures by flood and fell. . .

"It requires more training in its explorers abroad, more knowledge on the part of its readers at home. The days are drawing to a close when one can gain undying geographical renown by struggling against man and beast, fever and hunger and drought, across some savage and previously unknown region, even though little can be shown as the outcome of the journey. All honour to the pioneers by whom this first exploratory work has been so nobly done! They will be succeeded by a race that will find its laurels more difficult to win—a race from which more will be expected, and which will need to make up in the variety, amount, and value of its detail, what it lacks in the freshness of first glimpses into new lands."

These comments apply with particular force to Polynesia. Pacific exploration has, in fact, only begun to go beyond its primitive stage. Discovery, high-handed annexation, the claims and bickerings of world Powers, travel for its own sake, missionary activity by numerous sects, phosphate digging, agriculture, commerce in copra, pearls, and trepang—these have gone on here and there for a hundred years, but the increase of exact knowledge has been relatively small. Whole tribes of splendid aboriginal peoples have melted away under the blights of civilization before their traditions could be recorded or their relationships determined. With the decimation of the native Polynesians, some of their culture plants, such as many varieties of breadfruit which require human nurture, have also tended to disappear. Abnormal concentration of copra gatherers or pearl fishermen upon small islets has worked its evil effect upon the face of nature. Moreover, the acclimation of alien fruits, and of weedlike shrubs, such as the guava and lantana, has changed the entire aspect of the flora on certain islands. Nor has the fauna suffered less severely. In the path of the heedless white exploiter many a defenseless ground-living bird vanished so long ago that it is now only an obscure name in the annals of ornithology. Foreign animals, domestic or wild, have added to the destructive changes. The introduction of sheep, dogs, cats, and even of the mongoose, into islands which had no indigenous mammals, together with the rapid spread of starlings and weaver finches, and of a hawk transported from Australia, makes it inevitable that still more of the original Polynesian birds are doomed to go the way of the lost species, perhaps even before they are known to science.

In short, from earliest times the study of natural history in the Pacific has been subordinate to other aims. The all but mythical Spanish navigators of the sixteenth century, such as Alvaro Mendaña de Neyra, who discovered the Marquesas Islands about 1595, carried no savants in their galleons. So far as we know, their travels were spurred on by the incongruous medieval motives of conquest and sal-

ROLLO H. BECK, LEADER OF THE WHITNEY SOUTH SEA EXPEDITION
Mr. Beck is seen, notebook in hand, recording a find on Fakarava Island. The nest is that of a brown booby (*Sula leucogaster plotus*). The "France" is in the offing

vation, both to be ruthlessly imposed upon all the brown-skinned infidels. The voyagers of the Golden Age of exploration, like Bougainville and James Cook, were accompanied by naturalists who brought back to Europe the first examples of many historic plants and animals, but their expeditions were mainly concerned, nevertheless, with pure geographic discovery and with observing as-

Mr. Quayle and his Polynesian guide searching for the breeding ground of the *nohuá*, or Tahitian petrel (*Pterodroma rostrata*), among lofty, forested ridges on which Titian Peale first discovered the species more than eighty years ago

tronomical phenomena such as a transit of the planet Venus. Subsequently, land collecting of an incidental sort has been undertaken by oceanographic expeditions, such as those of Darwin's ship, the "Beagle," the fleet under command of Wilkes during the United States Exploring Expedition of 1838–42, or the Bureau of Fisheries steamer "Albatross" during her several Pacific voyages. Finally, naturalists on long yachting cruises, or working entirely as free lances, have added sporadically to our knowledge of the Polynesian groups. Most of the South Pacific collections in modern scientific museums consist of fragmentary material derived from such sources, and, so far as birds are concerned, no other part of the world still affords so many species either inadequately represented or totally lacking in *all* museums.

So much for the opportunity—an opportunity which it was necessary to seize within the span of the present generation if it was not to slip away irrevocably.

THE WHITNEY EXPEDITION IS LAUNCHED

Four years ago, Dr. Leonard C. Sanford, a Trustee and Honorary Fellow of the American Museum with an ardent interest in oceanic birds, induced Mr. Harry Payne Whitney to support a notable project in the Pacific. The choice of a leader in the field was fixed by virtue of former accomplishment upon Mr. Rollo H. Beck, a veteran exploring naturalist who had previously served the Museum on expeditions in South American waters and elsewhere. Fortunately, the plan appealed to Mr. Beck, and so, in August, 1920, the Whitney South Sea Expedition was launched.

Space will not permit an account of the argonautic travels of Mr. Beck and his successive associates, Messrs. Quayle and Correia, but brief glimpses of their experiences have been given by the leader himself in various issues of NATURAL HISTORY.[1]

Suffice it to say that after a reconnaissance of the classic isle of Tahiti, and of several neighboring parts of Polynesia, Mr. Beck purchased the auxiliary schooner "France," a step which made the expedition independent of sailing schedules and trade routes. Flying the burgee of the Museum, the "France" has since visited more than a hundred islands of the Society, Marquesas, Line, Tuamotu, Austral, Cook, and Samoan groups, and has now proceeded to the rich field of the Fijis, in Melanesia. Collection and study of the birds of the South Seas have been the primary objects, but many other animals and a large assemblage of plant specimens have likewise been obtained. The camera, moreover, has been brought constantly into use, and the photographs illustrating the environment, the animal life, and the appearance and customs of the human inhabitants, are of utmost value,

[1] "Visiting the Nests of Seabirds by Automobile" (July-August, 1921); "A Visit to Rapa Island in Southern Polynesia" (January-February, 1922); "Bird Collecting in Polynesia" (November-December, 1922); "The Voyage of the 'France'" (January-February, 1923).

especially those made at localities—regrettably numerous—in which the state of the fauna and of the people is altering materially in response to external transformations.

Enjoying the coöperation of the Bishop Museum of Honolulu, present-day headquarters for Pacific research, and with courteous assistance from French, British, and American officials among the far-flung archipelagoes, the Whitney Expedition has been enabled to carry out its mission in a manner hitherto impracticable owing to problems of time, distance, and expense. The specimens and notes thus far received at the Museum provide data for comprehensive reports upon Pacific birds, and for distinctly new exhibits; they also put us in the happy position of being able to supply sister institutions in other parts of the world with species which they might otherwise never acquire.

Although several thousand birds have been collected in the course of the field work of the Whitney Expedition, emphasis should be placed upon the fact that no excessive destruction of life has been countenanced. In the case of sea birds, the specimens have been taken mostly on the open ocean or in colonies made up of thousands of their kind. The majority of the land birds have had a natural protection in the rough country or almost impenetrable jungle in which it has been necessary to seek them. Moreover, the determination of Mr. Beck to collect as many *kinds* of birds as possible at each island, has in itself limited the representation of any one species from a single locality. In the past, most ornithologists have shot two or three warblers, flycatchers, doves, or what not, at the first island in their itinerary, and have thereafter been content to record in their notebooks that the same sorts were "present" at islands subsequently visited. But it is now known that many Polynesian birds vary unaccountably from island to island, and that distinct species, or geographic forms of the same species, are often mutually exclusive occupants of two bodies of land so close together that they may be within sight of each other. Mr. Beck's instructions were to take nothing for granted, but to obtain examples of the entire avifauna at every islet on which he landed, regardless of whatever duplication this might seem to involve. The procedure has been thoroughly justified by the results: duplication has been relatively slight, and the collections illustrate the extraordinary plasticity of numerous types of both land and sea birds,—a truth not generally suspected until recent years, even though Darwin long ago described similar phenomena evident at the Galápagos Islands.

SEASONAL VISITORS FROM THE ARCTIC

The birds of Polynesia naturally exemplify a wide variety of both marine and terrestrial forms. Dividing the avifauna in another way, we may distinguish the indigenous breeding species from seasonal migrants which come regularly to the South Seas from nesting grounds in Alaska or Siberia, or which wander northward from south temperate or subpolar regions. To these travelers we can here give only passing attention, but it is a marvel how such shore birds as our familiar sanderling, the turnstone, wandering tattler, bristle-thighed curlew, and Pacific golden plover, make almost incredible flights from the Arctic tundra to smiling islands far south in the greatest of oceans. The golden plover is as much at home in dry uplands of the Marquesas as it once was on the downs of Montauk. The eggs of the wandering tattler have only recently been discovered in Alaska; who would suspect the distance of its birthplace if he saw the little gray snipe skimming above the thundering reef of Raiatea? The boreal breeding ground of the bristle-thighed curlew is still wrapped in mystery, although the bird was made known a century and a half ago from the heart of its winter range, a fact commemorated by its specific name—*Phæopus tahitiensis*.

Besides the snipes and the plovers, a few birds of more pelagic life make the long journey from the Arctic.

Both the parasitic and the pomarine jaeger, for example, come to Polynesian waters to harass the native terns. From the opposite direction, certain albatrosses and petrels retreat before the Antarctic twilight at least as far as the southerly border of the area.

TROPICAL WATER BIRDS

The resident water birds of Polynesia belong to the families of the petrels, terns, sandpipers, the Steganopodes or oar-footed swimmers, the herons, ducks, and rails. The make-up of several of these groups is as notable for its omissions as for its representations. Gulls, cormorants, pelicans, geese, and plovers, for instance, are wanting at all the southern oceanic archipelagoes, although some of these occur in New Zealand or Hawaii.

A gadfly petrel (probably *Pterodroma neglecta*) on its breeding ground at Ducie Island

Tropical types of petrels, shearwaters, and Mother Carey's chickens—the most truly oceanic of all birds—are common throughout Polynesia. Many kinds nest in burrows, either in the coral sand of atolls or in the moist soil of mountain rain forests. When the United States Exploring Expedition visited Tahiti in 1839, the naturalists worked their way through the jungle-covered steeps to altitudes above six thousand feet, and there found the homes of a new species of brown and white petrel which Titian Peale named *Procellaria rostrata*.[1] This bird, the *nohuá* of the Tahitians, was rediscovered by Beck and Quayle in the same mountain ridges after many weeks of hunting, and subsequently was dug out of its burrows on the western Society Islands.

A smaller though similar petrel, likewise described by Peale, is *Pterodroma parvirostris*, which seems to be confined to islands of scanty vegetation, thus avoiding competition for nesting sites with the preceding species. It has been obtained during the Whitney Expedition at Christmas Island, close to the equator, and among the Tuamotus, as well as on the leeward or dry slopes of some of the Marquesas.

Several exceedingly rare relatives of these two birds—rare in the sense that they have always been poorly represented in museum collections—are the "gadfly petrels" of somewhat more southerly latitudes, which nest upon the surface of the ground. The descriptive appellation is derived from the genus name *Œstrelata*, by which these birds were formerly known, and relates to the fact that their swift, twisting flight suggests the actions of creatures goaded to madness by such an insect as Hera sent to torment Io. Among the Austral Islands, especially at Bass Rocks, the last outpost between eastern Polynesia and the Antarctic, members of the expedition found several species of gadfly petrels in great abundance, while at the uninhabited islands of Henderson, Oeno, and Ducie, not far from Pitcairn—lonely home of the "Bounty" muti-

[1] This species is now called *Pterodroma rostrata*. All but a few copies of the work in which it was described—Volume VIII in the reports of the United States Exploring Expedition, *Mammalia and Ornithology*, 1848, by Titian R. Peale—were destroyed by fire before distribution. The volume was never reissued, but was replaced ten years later by a work of the same title from the pen of John Cassin, who quotes much of Peale's text. Peale's own work, which is filled with the original descriptions of birds and mammals, has therefore always been one of the rarest and at the same time one of the most important reference books on systematic zoölogy. Until last year the American Museum Library did not possess it, when an extraordinarily fine copy was purchased at auction and presented to the institution by Mr. James B. Ford.

Sooty terns (*Sterna fuscata*) above the great breeding colony on Kauehi Island, Tuamotu Group

The eastern coast of isolated Henderson, or Elizabeth, Island.—Uninhabited by man, its tangled woods are the only home in the world of four species of birds: a flightless rail (*Nesophylax ater*), a rose-crowned fruit pigeon (*Ptilopus insularis*), a red and green lory (*Vini stepheni*), and a warbler (*Conopoderas taiti*).

neers—the soil beneath thickets of gnarled and stunted trees was covered with tens of thousands of the white eggs or powder-puff chicks of the birds.

Of smaller petrels, the swallows of the sea, numerous interesting species from many localities have been sent to the Museum. Some of the specimens have already thrown new light upon classification and distribution, and have shown that the demarcation of ranges is no less sharp on the supposedly uniform and "boundless" ocean than on the highly varied surface of a continent. Winds, water temperatures, differences of salinity, and other physical characteristics, with all that they imply in the ecology of oceanic life, are the fences of the sea; and maritime birds of specialized feeding habits cannot stray outside their own peculiar sphere any more regularly or successfully than birds of mountain woodland can thrive on grassy plains or desert-dwellers in the marshes. We can stop to speak of but a single one of the Mother Carey's chickens of the Pacific, namely, the historic, streaky-breasted bird known as Peale's petrel. The type specimen was taken at Samoa in 1839, and only one or two additional examples had been reported during the decades that intervened until Mr. Beck shot one off the Marquesan island of Huapu on September 15, 1922. The species had been known hitherto by the generic name of *Pealea*, created especially for it, but a comparative study now discloses the fact that the bird is in reality closely akin to various other small Pacific petrels instead of being a highly aberrant offshoot. Only the dearth of pertinent material in museums prevented an earlier appreciation of this fact.

The absence of gulls among the islands is offset by the abundance of terns, no less than ten different members of this family being found in eastern Polynesia. One, the crested tern (*Thalasseus bergi*), is as large as some of the gulls. The others are smaller, two of them, the blue and the gray ternlets, being among the tiniest of terns. Noddies of two kinds, one prevailingly brown, the other black, are extraordinarily numerous at practically all the Pacific islands, while the size of the breeding colonies of the sooty tern, or wideawake (*Sterna fuscata*), beggars description. Suffice it to say that the Yankee whalemen, who were accustomed to gather the eggs of this bird for food, reckoned the population by "acreage" rather than by numbers, and so recorded the extent of the colonies in their log books.

THE WRAITHLIKE FAIRY TERNS

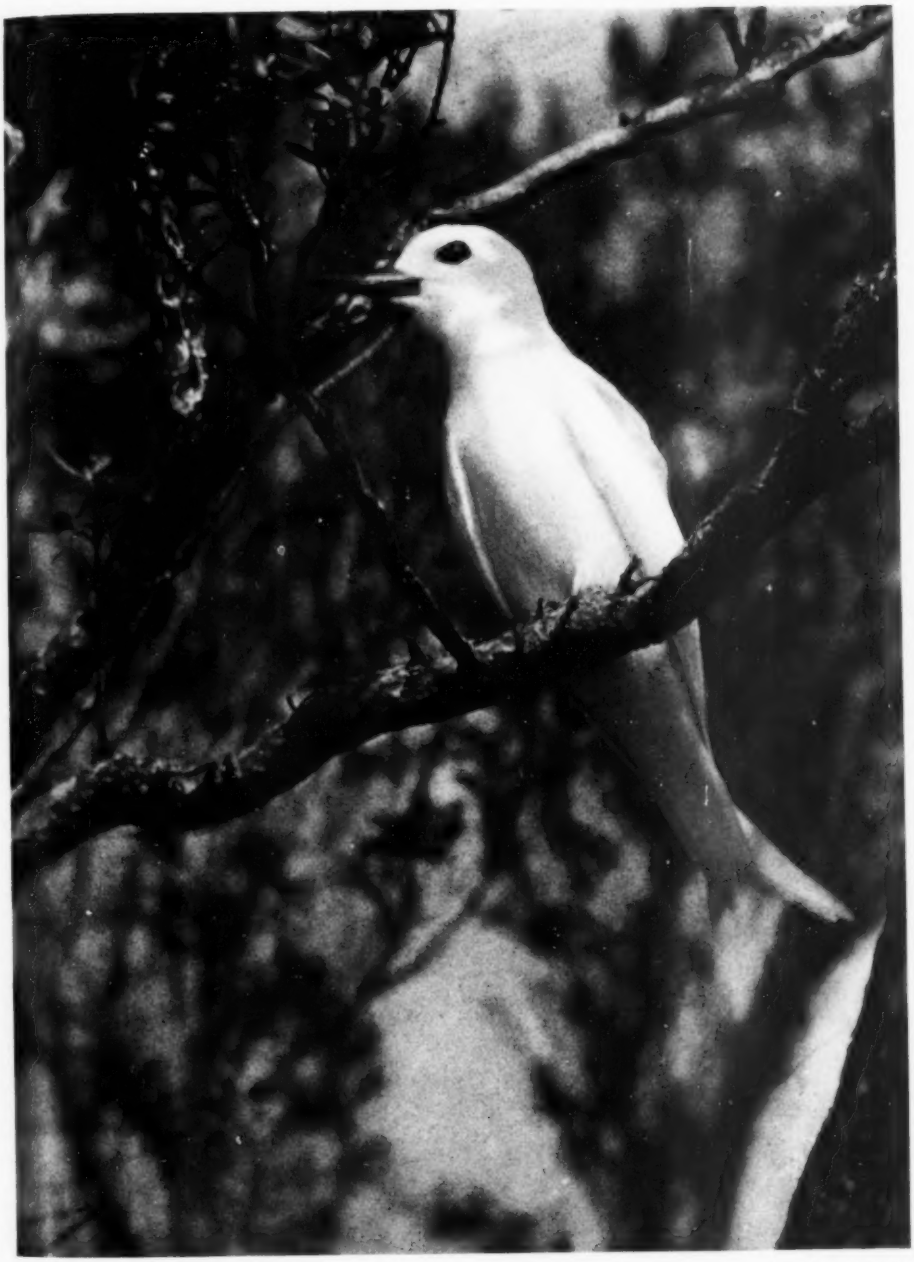
Antitheses of the dark noddies are the exquisite fairy terns of the genus *Leucanous*, perhaps the most delicately beautiful and ethereal of all sea birds. The Spanish voyagers likened them to the dove in which the Holy Spirit became incarnate. The adults are pure white, with dark bills and feet, and exceptionally large eyes. When their wraithlike forms flutter overhead, it seems as though the sunbeams or the glow of the tropical sky were penetrating their bodies like x-rays, for the thinly covered bones of the wings become visible through filmy plumage.

The fairy terns have reacted in a subtle manner to their environment, for a distinct race of very small size seems to be peculiar to certain of the Marquesas Islands, while those inhabiting southern Polynesia, beyond the zone of trade winds, differ in other ways from the ordinary equatorial representatives. All, however, are tree or shrub dwellers, as are also the noddies. But the noddies build platforms which, by courtesy, may be called nests, while the fairy tern lays its single egg upon a broken stub, the bark of a bare limb,[1] or even on the slippery shaft of a palm frond.

MAN-O'-WAR AND TROPIC BIRDS

In the rather heterogeneous order of sea birds known as Steganopodes, the Polynesian members comprise three species of boobies, two of tropic birds, and two of man-o'-war birds. All of these belong to wide-ranging species, with forms of close affinity in other warm oceans. The Pacific man-o'-

[1]For a photograph of such a precarious nest site the reader is referred to the issue of NATURAL HISTORY for January-February, 1923, p. 40.



A fairy tern of Fakarava, Tuamotu Group.—This species (*Leucanous albus*), with its snowy plumage, blue and black bill, extraordinarily large eyes, and unsuspicious mien, is one of the loveliest of sea birds. It is a perching tern, usually alighting on twigs or crags. Its single egg is deposited on the rough bark of a horizontal limb, upon a broken stub, or even on the shaft of a palm frond. More rarely it is found in a niche of a coral ledge

war birds are of two kinds, one considerably larger than the other, but their habitats seem not to be sharply differentiated, for sometimes both nest upon the same islet. The boobies are more definitely separated in their manner of life, for the red-footed booby nests in trees, whereas the

Man-o'-war birds resting above the shimmering waters of Eiao Island, one of the Marquesas

brown booby and the blue-faced booby lay their eggs on the ground. Thus in breeding habits the red-footed booby is associated with the man-o'-war birds, while the other species align themselves with the handsome red-tailed tropic bird (*Phaëthon rubricaudus*). The latter, which is garbed in rosy plumage of satiny sheen, can neither perch nor stand up. It nests on the ground, often in good-sized communities, and it must shuffle away on its breast be-

fore taking flight. The long red plumes of this tireless flyer have always been prized ornaments of the South Sea people. Readers of Herman Melville may recall that when the Marquesan chief, Mehevi, sought to impress the captive author of *Typee*, he came to him with his head gloriously crowned with the erect, crimson feathers. Bennett and other voyagers tell us that islets prolific in this special source of wealth, such as Tubai of the Society Islands, were monopolized by the royal Polynesian rulers, and considered the hereditary lands of their families. It may be added, however, for the benefit of more civilized wearers of avian millinery, that the islanders never took the life of the bird which supplied the treasure; they merely plucked out the tail of the fearless or stolid creature while it sat upon its egg, causing no damage whatsoever, unless the bird's pride be taken into account.

The genus of the tropic birds has been appropriately named after that daring son of Apollo whose sky-riding ended in a headlong plunge. Just so the birds drop like arrows from the blue vault, to disappear—but only for a moment—beneath the water. Much smaller than the red-tailed species is the yellow-billed tropic bird (*Phaëthon lepturus*), which has broader, white tail plumes, and which differs also in confining its nest sites to niches in the face of lofty hills.

Of other water birds, a teal which looks like a small edition of the North American black duck is widely distributed among such islands as have fresh-water ponds or marshes. A small "fly-up-the-creek" (*Butorides stagnatilis*), akin to our green heron, haunts the vales of running streams, and is therefore lacking on the atolls, while the reef heron, notable for its puzzling color phases—white, dark blue, and mottled—is characteristic of lagoon shores. On broad coral rings of the Tuamotus this bird sometimes temporarily forsakes its salt-water fishing for a banquet of lizards from the palm boles.

Without dwelling further on the Pacific water fowl, we must say something of the all but unknown native sandpipers and rails, before turning to

Frigate, or man-o'-war, birds (*Fregata minor palmerstoni*) nesting at Hatutu Island of the Marquesas

The red-footed booby (*Sula piscator*), a long-tailed, perching species and the only Pacific booby which constructs a nest in trees or bushes. Coast of Hatutu Island, Marquesas Group

strictly terrestrial birds. Two or more forms of diminutive shore birds belonging to genera called *Prosobonia* and *Æchmorhynchus*—and related, it is alleged, to a rare snipe of the southern Andes!—were found by the early voyagers at many South Pacific localities. In some of the less sophisticated writings they are referred to as "quails." Although too small to be worth shooting in a region where edible pigeons and ducks abounded, the sandpipers in one way or another became generally exterminated. *Prosobonia* has never been rediscovered, and the only existing specimen is treasured in the Leyden Museum. Previous to the Whitney Expedition not more than five or six examples of the other genus were scattered through ornithological collections of the world, but at certain remote atolls of the multitudinous Tuamotus Mr. Beck encountered Peale's species, *Æchmorhynchus parvirostris*, as a yet common bird. To read in Beck's notes of how these sandpipers, which remind one of tiny upland plovers (*Bartramia*), scurried in flocks before him along the breezy strands, or perched within arm's reach on the mangrove branches while he was eating his lunch, is thrilling to an ornithologist who previously had known only vague bookish descriptions of the bird's appearance.

Several kinds of rails and gallinules were native to Polynesia. At least two of these are now extinct, and still more have never been represented in the museums of America. One small secretive, red-legged, black rail has been given an assortment of scientific names, according to the place of origin of the respective specimens; but a study of skins obtained during the Whitney Expedition at seventeen different islands between Oeno and Samoa indicates that a single unvarying form, which should be called *Porzanoidea tabuensis*, ranges throughout numerous archipelagoes. The stability or fixity of certain supposedly ancient types of birds, when contrasted with the remarkable geographic variability of others, is hard to interpret; the fact merely stands as one of the unsolved problems of evolution. However,

An incubating blue-faced booby (*Sula dactylatra*), largest of the Pacific species and a ground-nesting bird. Photographed at Maria Island, Tuamotu Group

at Henderson Island, which is partly surrounded by the insular range of *Porzanoidea tabuensis*, there exists a larger, quite distinct black rail which has completely lost the power of flight through a reduction in the size, number, and stiffness of its wing and tail quills. This strange bird, known only since 1908, is sufficiently different from its small cousin to be placed in a new genus, and it has been described by the writer as *Nesophylax*, the "island guardian."

A quaint home of the widely distributed reef heron (*Demiegretta sacra*), built in the hold of a wrecked hulk at Tahiti

LAND BIRDS OF POLYNESIA

The land birds of the South Seas are obviously of Asiatic origin, but, quite aside from the unique avifauna of Hawaii, many peculiar species and genera have had time and impetus to develop in different island groups. The invading white man, furthermore, is responsible for the recent introduction of hawks, weavers, the so-called mina, rock pigeons, Indian bulbuls, and others. The ancestors of still another interloper, the jungle fowl, were brought by the savage Polynesian navigators on their early migrations, and, long before the advent of Europeans, feral poultry had become established on all the larger wooded islands.

Indigenous species belong to the families of the fruit pigeons, tooth-billed pigeons, quail doves, lories or brush-tongued parrots, true parrots, barn owls, swifts, kingfishers, cuckoos, swallows, Old World flycatchers, starlings, Old World warblers, and several others; but not all of these occur in any single cluster of islands. Thus the remarkable tooth-billed or dodo pigeon (*Didunculus strigirostris*)—not to be confused with the extinct dodo—inhabits only the main islands of Samoa. It was at one time greatly reduced through hunting by the newly armed natives and the ravages of their half-wild domestic cats, but is now, perhaps, increasing.

Most exquisite of all Pacific birds are the fruit pigeons, clad in soft feathers of gray, blue, yellow, metallic green, and pastel hues, with caps of white, or lilac, or mauve, or blazing violet-rose. Some of these, such as the purple-crowned pigeon (*Ptilopus coralensis*) of the Tuamotus, and the white-crowned pigeon of the Marque-

sas (formidably named *Ptilopus dupetithouarsi* in commemoration of the naval officer who took possession of the islands for France), have relatively wide ranges. Others, like the Tahitian species (*Ptilopus purpuratus*), are confined to two or three islands. In still other instances, magnificent forms are restricted to a single dot of land in the wide sea; their destruction throughout a few square miles would mean the blotting out of a wonderful unit of creation. One of this category, *Ptilopus chalcurus*, found only on the uplifted coral isle of Makatea in the Tuamotu group, leads a naturalist to suspect

Purple-crowned fruit pigeons (*Ptilopus coralensis*) of the Tuamotu Archipelago, accepting berries from the captain of the "France"

that the topographic and consequent floral change resulting from geological disturbance was in some way responsible for the evolution of this bird from the stock of *Ptilopus coralensis*, for the latter lives on all the lower islands round about.

A long-tailed, raspberry-breasted fruit pigeon of Rapa, the southernmost islet of eastern Polynesia, was known previously from only one specimen in the museum at Turin, Italy. It represents the type of a new genus which has been described from Whitney Expedition material as *Thyliphaps*, the "pigeon of Uttermost Thule." The beauty of all of these birds in life passes description; even their dried skins, in the words of a visitor to the Museum, remind one of blood oranges, of peacock's tails, of precious stones!

The quail doves are no less fascinating than the fruit pigeons, and are even more rare because their ground-living habits have rendered their young easy victims of cats and hogs. Five or more kinds have thus far been taken by the staff of the "France," of which the Marquesan species (*Gallicolumba rubescens*) is for historical reasons the most important. This bird was discovered by the Russian explorer, Krusenstern, in 1813. He brought back no specimens in his ship, but published a crude drawing of the bird in the Atlas of the voyage. From that date until October, 1922, the Marquesan quail dove was not seen by a naturalist. Its appearance, relationships, its very existence, indeed, were all doubtful until Mr. Beck found it still frequenting the brushy hillsides of Hatutu and Fatuhuku.

THE KINGFISHER, BIRD OF AUGURY

The small, blue and green Polynesian kingfishers, the colors of which change astonishingly according to the angle of light, seldom if ever wet their wings by diving into streams. They prefer to forage for insects and for the lively lizards which scuttle through the vegetation. No species has an extensive range; the kingfisher of Tahiti is even different from that of neighboring Moorea. In the Society Islands the kingfishers were regarded as sacred birds, "givers of good and bad fortune," according to Sir Joseph Banks, who accompanied Cook on the latter's first voyage of circumnavigation, a tradition perpetuated in the technical name of the Tahitian species —*Todirhamphus veneratus*. The immortal Cook himself, in recounting a human sacrifice which he witnessed, states that the officiating priests awaited the voice of a god, which was finally expressed through the rattling call of a kingfisher.

Hitherto all the known South Pacific kingfishers have come from more or less mountainous islands, but the Whitney

Expedition has obtained at Niau, of the Tuamotus, the new species portrayed in the frontispiece, which has been dedicated to Mrs. Whitney.

Of other land birds we can speak here but briefly. Merchants of Papeete, the metropolis of French Oceania, tell of their boyhood sport of trying to knock down with switches the low-flying *opeias*, or edible-nest swifts (*Collocalia thespesia*), which were formerly common in the streets of the town. This bird, one of a group famous as the source of Chinese bird's-nest soup, has now disappeared from Tahiti, although it still holds out elsewhere. The parrots of eastern Polynesia apparently vanished long ago, but lories the size of sparrows, and bizarre in red, blue, and emerald plumage, still inhabit the less-settled islands. Some of the lories are favorite pets of the Polynesians, who have transported them hither and thither until little clue remains as to their natural distribution. A speckled, pale-blue species (*Coriphilus smaragdinus*) is still peculiar to the Marquesas. A dark blue, white-throated lory of the Society and Tuamotu Islands was evidently first brought to Europe without a label, for in 1776 the zoölogist Müller described it as *Psittacus peruvianus!* Despite the anachronism, the specific name has priority over others more appropriate, and the libel on this paroquet's nationality must stand forever.

A similar error accounts for the name of the sweet-voiced Tahitian warbler (*Conopoderas caffra*), which the eighteenth century naturalist, Sparrman, evidently jumbled with birds obtained in the land of the Kaffirs (i.e. South Africa). The bird is related to the reed warblers of Eurasia, and its genus has run riot in Polynesia, for a distinct race, differing in size, proportions, or color from all relatives, seems to occur at each small assemblage of islands or, sometimes, upon a single islet. Large, yellowish types, represented by certain subspecies of the Society and Marquesas, are at one end of the series, and the very small, gray warbler of Christmas Island is at the other end. Even more diverse in size and pattern are the insular flycatchers of the genus *Pomarea*, named for the old kings of Tahiti. The Tahitian flycatcher (*Pomarea nigra*) is one of many South Sea species included in Lord Rothschild's monograph on *Extinct Birds* (1907); but Mr. Beck has shown that it still thrives in the mountain fastness of the queen of isles.

WHAT THE FUTURE HOLDS IN STORE

With reference to opportunities still before the Whitney Expedition, Doctor Richmond, of the United States National Museum, has reminded the writer that for many years the belief prevailed that the bird life of Hawaii was well known—that the ornithology of the group was, indeed, a "finished product." Then, about 1887, one or more naturalists began to investigate these islands in the modern, intensive manner, and *ten new genera* were discovered. We may hope for a similar prospect in the South Seas. Hundreds of islets have not yet been searched by trained men. In the secluded mountains of even the largest and "best known" islands there may well be unknown secretive birds which have not yet withered away before man and the pests he brings with him. The Whitney Expedition has demonstrated its effectiveness; its results will arouse a public sentiment which may become the only means of saving certain birds from extinction; it is assuredly paving the way for a fuller understanding of biological and zoögeographical problems in a long-neglected quarter of the globe.

SUNSET AT SEA

Photograph by Julian A. Dimmock

The Oceans

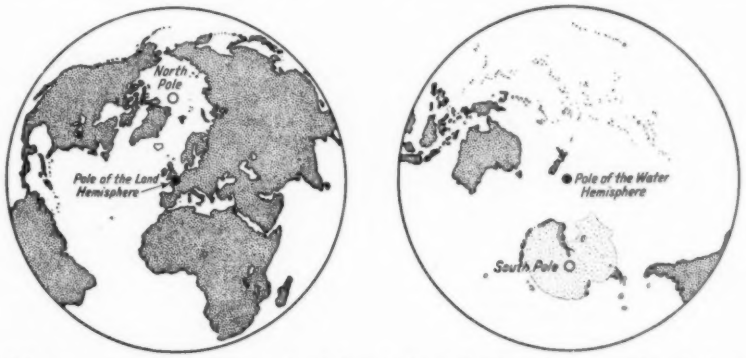
By WILLIAM MORRIS DAVIS
Sturgis-Hooper Professor of Geology, Emeritus, Harvard University

WHEN primitive man, wandering over the solid lands that supported his tread so well, came upon the "great waters" which would not support him and which could not be drunk because of their saltiness, he must have regarded them as very mysterious if the human mind had at that early time acquired the capacity of conceiving anything so abstract as a mystery. The unseen extent of the waters beyond the smooth horizon line must have seemed utterly unknowable; if other lands lay on the farther side of the waters, they could not be reached.

Those early mysteries are now solved. The extent of all the oceans has been measured, their shores have been charted, and few, if any, oceanic islands remain to be discovered; the depths of the oceans have been sounded at many points, and samples of bottom deposits have been brought up to the surface for study; the movements of the oceans in waves, currents, and tides have come to be fairly well understood. But new mysteries now confront us; and of these, the most fundamental is: what is the origin of the vast sheet of water that so evenly covers three-fourths of the earth's surface to an average depth of about two miles? Older and newer hypotheses have been framed to answer this question, but no certain knowledge has been reached. A generation ago, when most geologists confidently believed the earth to be a

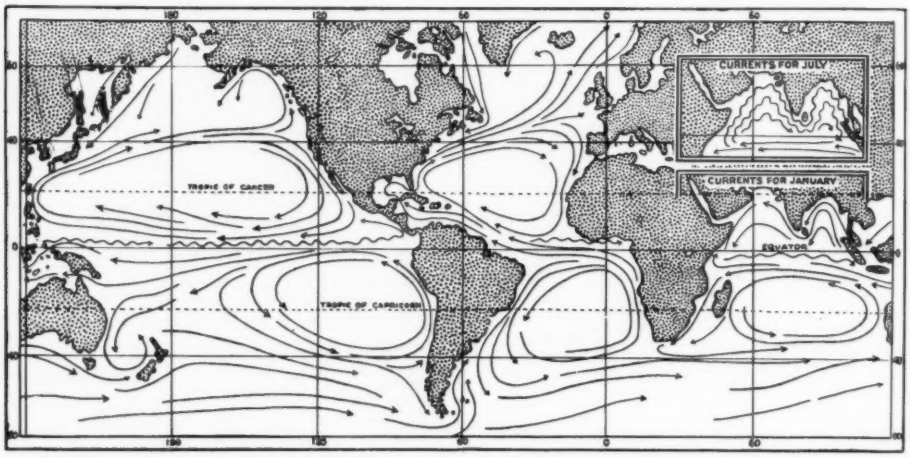
cooled-down aggregation of hot matter slowly gathered from an ardent chaos, the ocean was supposed to have been first formed, after the temperature of the earth's crust had been reduced enough to allow water to remain upon it, by the gradual condensation of rainfall from the heavy, steamy atmosphere which had long shrouded the globe while it was still glowing with heat. But today the confident acceptance of that earlier view is shaken by the introduction of a very different concept, according to which the earth has been built up slowly of scraps of cold matter—planetesimals—loosely at first, when its mass was small and its gravity was therefore weak, more compactly as it grew to greater and greater size and the cold exterior weighed down more heavily on the cold interior; more compactly still when the increasing outer parts crushed the inert inner parts and thereby generated a growing store of interior heat, thus providing for a beginning of the various processes of vulcanism. Eventually, as the present size of the earth was approached and reached, volcanic eruptions became powerful and frequent enough—as they still are—to expel great volumes of gases from the interior and to pour out vast floods of lava; and in so far as these gases included water vapor, a large part of it cooled and condensed in clouds and fell as rain; then—as was also supposed in the earlier hypothesis—the rain water gathered into streams and, even with greater fluidity than the molten lava, ran down the slopes of the lands and spread out with a level surface in the primitive depressions. Thus explained, the oceans began to form from a supply of interior or telluric water, not of exterior or atmospheric water; and thus they have continued to grow to greater and greater volumes through the geologic ages; thus they may, according to the later hypothesis, be growing still. It is impossible to say which one, if either, of these explanations is true; but in this sort of long-range archery, it is well to have two strings to one's bow.

The present relation of the unevennesses of our planet's surface to the volume of the ocean waters is such that the oceans are deep enough to cover the greater part of that surface in a continuous sheet, and that the lands emerge in only one quarter of the whole. The continents have generally been built in large patterns—who can say why?—and most of them are contiguous in one hemisphere. The other,



The globe may be divided into a land hemisphere (left) and a water hemisphere (right). London is close to the pole of the former; the pole of the latter is in the ocean near New Zealand. Drawn by W. E. Belanske

or water hemisphere, in which New Zealand lies near the pole, is almost wholly oceanic; it includes all the Pacific as well as the adjoining waters known as the Antarctic Ocean, and a good part of the Indian Ocean; of larger land areas it includes only the outlying masses of Australia and Antarctica, and the narrowing part of



Map of the world, showing the ocean currents.—In the monsoon region of India, the winds reverse their direction every six months, and therefore two sets of ocean currents are shown for this region. After Davis

farther South America. The land hemisphere, in which, curiously enough, the capital of the greatest colonizing nation of the world lies near the pole, has for its oceanic area only the winding, canal-like Atlantic with its gulflike Arctic termination and its mediterranean attachments, east and west, along with an oblique northwestern slice of the Indian Ocean.

Although the salt waters of the world —barring certain inland lakes—are thus continuous, they are naturally divided by a system of ocean currents, and also artificially for purposes of naval administration, into seven oceans, the North and South Atlantic, the North and South Pacific, the Indian, the Arctic, and the Antarctic. The first five are all characterized by wind-driven, slow-moving, clockwise-turning[1] currents of small depth, which eddy around their central and relatively stagnant sargasso seas. The small circum-Arctic eddy, rimmed in by the continents, is in gear with and therefore turns opposite to the North Atlantic eddy. The much greater Antarctic eddy, which rims an ice-covered continent, is in gear with and turns opposite to the three southern eddies.

The two Atlantic eddies are peculiarly related: they become confluent in the torrid zone, but by reason of the different relations of western Africa and eastern South America to the equator, a large branch of the southern eddy is diverted obliquely across the equator to the northern eddy; evidently, therefore, an equivalent branch must be diverted from the northern side of the northern eddy, west of Ireland, and directed past Scandinavia

[1]It is often stated that these eddies turn clockwise in the Northern Hemisphere and counter-clockwise in the Southern; but it may be truly said that they both turn clockwise if we only remember in the case of the Southern Hemisphere to look at the other side of the clock, just as we there look at the other side of the plane of the equator.

to form the Arctic eddy. This diverted branch, improperly called the Gulf Stream—a name that should be restricted to the hurried and relatively deep current that issues from the Gulf of Mexico between Florida and the Bahamas—and properly called the northeastern branch of the North Atlantic Drift, is of moderate depth and of loitering movement, but still retains an exceptionally high temperature because of the long passage of its supply current through latitudes of strong sunshine; and as a result the surface water of the Atlantic off Norway and the air lying on it have a greater excess of temperature over the mean of their latitude than is the case in any other part of the world—all because of the asymmetry of Africa and South America.

The existing distribution of land and water on the globe has not always obtained; for the continents include many stratified rocks which, as their fossils indicate, have been laid down in the oceans of different geological ages; but these strata are relatively shallow-water deposits and therefore indicate only moderate changes of level. None of the lands, with the possible exception of certain Australasian islands, has been uplifted from oceanic depths so great as to exhibit true deep-sea deposits. On the other hand, certain continents have lost part of their former extent, for their border structures are clearly truncated by the shore line, just as the end of a board is cut across its grain; they must have originally continued into what is now the ocean, and in some regions into what is now the deep ocean; hence their lost portions have been strongly warped downward. The deep oceans thus seem to have been enlarged during the geologically recorded ages, and this perhaps gives confirmation to the second hypothesis, above stated, of the ocean's origin. Let no one, however, place too great confidence in this very tentative conclusion; for if what is now unknown about the greater part of the ocean bed ever comes to be known, our present views about it may be greatly modified if not altogether overthrown.

Although the volume of the ocean, however formed, is very small relative to that of the whole earth, and although the ocean depth is, therefore, comparable only to the thickness of the paper cover on a good-sized terrestrial globe, such is the extraordinary mobility of water that the ocean smooths itself out to a perfectly level surface, which is taken as the standard surface of reference for all calculations of the generalized shape of the earth as a somewhat irregular spheroid, or "geoid," as geodesists call it, and for all measures of the altitudes of the land. The tides periodically sway the ocean margins a little out of the level; and storm winds may locally brush up the surface into waves that rise for a time "mountain high"—for so indeed they seem when their rapidly advancing crests are viewed from their deep-sunken troughs, although their actual height is hardly fifty feet at the highest—but these tide and wind waves are minute wrinkles compared to the huge undulations of mountain ranges that are excited by slow-working geological storms of deformational forces in the earth's crust; and, moreover, the ocean waves soon quiet down again after the exciting storm has passed by, while the huge inequalities of the earth's crust on the lands, even though much degraded by erosional processes during their slow production, long remain as eminences before they are very slowly worn down

to lowlands; and by that time, new inequalities are produced elsewhere.

Not only has the ocean a uniformly level surface, but the greater part of its volume is uniform in various other respects also. The lands are made of many kinds of minerals and rocks, mostly of complicated chemical composition, and varying from place to place; but the ocean is made of one substance, water, of very simple chemical composition, the same everywhere. True, the ocean contains in solution a small quantity of a great variety of substances—of which the most abundant is the very soluble mineral salt, and among which even gold is minutely included—found in the continental parts of the earth's crust during ages of the most assiduous search by percolating ground waters and brought by rivers to the ocean, where they have very slowly accumulated to their present quantity, as is further told below. As a result, ocean water is about 2.6% denser than fresh water; but these many dissolved substances give no variety to the great volume of the ocean, because they are everywhere distributed in almost exactly the same proportions, partly by the circulation of the ocean currents, which in time mixes and remixes the whole content of the ocean, partly by the spontaneous diffusion of the dissolved substances themselves, in virtue of that extraordinary physical process according to which a solid dissolved in a liquid behaves like a gas.

Water is, moreover, so little compressible that the ocean is of almost uniform density from surface to bottom; in this respect it contrasts strongly with the gaseous atmosphere, which is so easily compressible that, while its lower layers are dense enough to permit seeds and sailing vessels to be propelled by the winds and to support birds and airplanes if they move rapidly enough through it, its upper layers are like a vacuum in their extreme tenuity. On the other hand, in spite of the pressures of two, three, or four tons to the square inch that are exerted at the greater oceanic depths, the bottom water is only about as much denser than the surface water as the surface salt water of the ocean is denser than the fresh water of lakes. Hence any object that is heavy enough to sink at the ocean surface will pretty surely reach the bottom; the old idea that even an anchor would cease sinking when it had descended to a depth where the water is compressed to the density of iron is a fable, with only about three per cent of trustworthy basis.

The ocean surface shares everywhere with the surface of the lands the changes of solar illumination from day to night and the irregular fluctuations of the weather. With the changes of the sky from clear to cloudy, the color of the ocean surface also changes wonderfully. Even the surface salinity varies, for drinkable water has been dipped up by ships at sea directly after a heavy equatorial rain. But the great undervolume of the ocean, below depths of two hundred or three hundred fathoms, knows little or nothing of these superficial changes. It is not only everywhere one substance and uniformly salt, as already stated; it is also persistently dark, for sunlight rapidly weakens with increasing depth of penetration. Some illumination of the deep ocean, it is believed, comes from the pale light of luminous organisms; and that the deep ocean is not so dark as terrestrial caverns may be inferred from the fact that many deep-sea organisms have eyes and colors, while various species of land animals which

have taken caverns as their abode, lose their colors and all but vestiges of their eyes and become gray-white, sightless creatures. The deep ocean, however, probably has no experience of day and night, and is, therefore, without the convenient measure of the passage of time that is based on the period of the earth's rotation, which the inhabitants of the land everywhere recognize.

The deep ocean is also a very quiet region; for the movement of surface waves and currents, like the penetration of sunshine, rapidly diminishes downward. The bottom waters would be absolutely still but for the slow and steady creeping of deep polar water toward the equator, of which more is told below, and but for the slight tidal oscillations. The latter must be extremely faint, but they are of interest as being, in the presumable absence of diurnal changes of illumination, the only periodic phenomena there experienced, and hence the only phenomena by which the passage of time is marked. Deep-sea organisms must, therefore, as far as they take cognizance of their tides, work on half-moon time; and in this they bear a resemblance to myriads of Crustacea and Mollusca on tidal shores, where in spite of the sun's determination of day and night, the moon regulates the order of animal life by its control of high and low water; and the same set of conditions governs mariners on coasts of strong tidal range, like the Bay of Fundy and the Channel Islands.

Rare and small departures from ocean-bottom stillness may be caused by earthquake waves, but in the watery depths they, like the tides, can show nothing resembling the activity with which they withdraw from and sweep in upon the shores of the lands. Exceptional disturbances are also caused by submarine volcanic eruptions, but these are so infrequent that quietness may still be considered a prevalent condition.

The deep ocean is not only dark and still, it is persistently cold; for by means of the vertical convectional circulation above mentioned the surface water that is chilled in the frigid oceans sinks and creeps very slowly to the torrid zone, where it must slowly rise. Be it remembered in this connection that unlike fresh water, which has its maximum density at 39° F. or 4° C., salt water is densest at its freezing point, about 28° F. or -2° C. Hence the great under-volume of the ocean in all latitudes has a temperature of between 30° F. and 40° F. or -1° C. and 5° C. The only significant exceptions to this rule are found in the basins of the enclosed mediterraneans, like the classic Mediterranean between Europe and Africa, the American mediterraneans known as the Caribbean Sea and the Gulf of Mexico, and several others in the Australasian region; the deep water of these basins, instead of being frigid, is only as cold as the open ocean at the level of their deepest entrance.

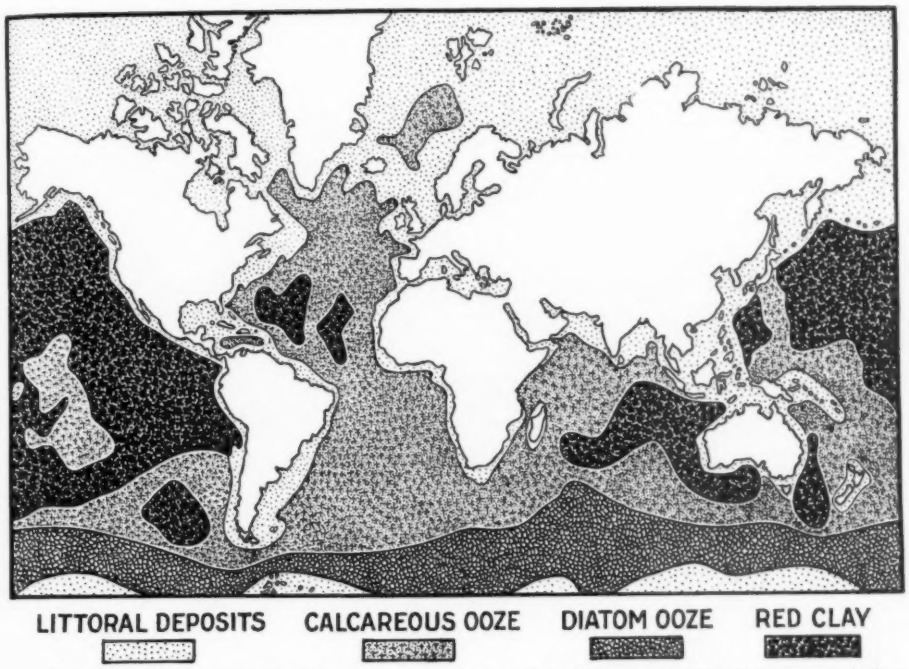
Moreover, the greater part of the ocean bottom is smooth and nearly level. Its levelness is locally interrupted here and there by volcanic cones, which have been slowly built up by countless eruptions, and which may or may not rise above the ocean surface as islands; and in a larger way by occasional flexures of large-curved cross-profiles, one of the greatest of which stretches northeastward from New Zealand, in a long swell adjoined by a deep trough, to the Tonga Islands in the South Pacific. Near certain continental shores, soundings discover the occurrence of

valleys and other erosional features, as if the continental border had been depressed in recent geological time, one of the best-certified of such features being the submerged valley of the Hudson, which trenches the continental shelf southeast of the river mouth of today.

Apart from these inequalities, however, the ocean bottom, as now known, is monotonously flat over large areas. But it is well not to generalize too confidently on this topic at present; for oceanic soundings are for the most part few and far between. Areas as large as Australia still remain in the Pacific without a single sounding to the bottom. He must be a bold man who ventures to draw a generalized chart of ocean depths! It is to be hoped that much more will soon be learned of oceanic depths by means of the "sonic depth finder," an instrument recently perfected in the research laboratory of our Navy and now in use on a number of our naval vessels in different parts of the world. This instrument measures depths in terms of the time interval between the emission of a surface sound and the return of its echo from the bottom. A vessel equipped with it does not have to stop a few hours to make a sounding, as is the case when piano wire and a detachable sinker are used, but may take successive measurements every few minutes while under full headway, even in rough weather.

Not only are the deep oceans persistently dark, still, and cold, and their deep floors prevailingly flat, but their bottom deposits, as brought up in sounding tubes and dredges, have small variety of composition. They consist chiefly of calcareous ooze over vast areas of lesser depth, down to about two thousand fathoms, and of a reddish clay in the greater depths. The ooze is composed of the delicate framework of minute organisms which live everywhere near the surface and which, on dying, sink slowly through the water, very much as a fine misty rain sinks through the atmosphere; but while such a rain is only of occasional, local, and short-lived occurrence, the fine organic rain in the oceans is perpetual and universal, and thus constitutes another of the many oceanic uniformities. The analogy goes a step further: for just as a fine rain, fed from lofty clouds, reaches a mountainous highland and yet may be evaporated before it descends a mile farther to the neighboring lowlands, so the fine organic rain of the oceans reaches the lesser depths as calcareous ooze, but is dissolved before reaching greater depths, probably because of increasing pressure, and only an insoluble reddish residue, the so-called red clay, sinks to greater depths; its accumulation there must be extremely slow.

In but one respect is the ocean less uniform than the rest of the earth: it is made of the only substance with which we have familiar experience in the three states that matter can assume. The surface water may freeze into ice of slight thickness in the frigid oceans; and then, as solid water, it holds its shape as well as its volume. As a whole, the ocean is liquid water, which maintains its own volume but accepts any shape and surface that external forces impel it to take; thus, under the force of terrestrial gravity, it is given the convex spheroidal surface which we call level. From its liquid surface, largely by the aid of the winds which bring drier air to replace damper air on its ruffled surface, a small amount of ocean substance passes off as invisible gaseous water,



Map showing the distribution of the oceanic oozes and clays.—Reprinted by permission, from *Textbook of Geology*, Part II, by Pirsson and Schuchert, published by John Wiley & Sons, Inc. Redrafted, with substitution of new symbols, by W. E. Belanske

which has neither definite shape nor volume, but which diffuses itself through the enveloping atmosphere, only to be sooner or later condensed into clouds and to fall here or there as rain or snow; and this leads us to examine the great scheme of terrestrial economics in which the waters of the vast oceanic reservoir play a leading part.

It is as if the ocean, proud of its own level uniformity, wished to see the continents also laid low and smooth, and with this object sent forth its vapors so that those which descend on the lands should bear back, when they return to the ocean, all the land waste they can carry; but the continents, resenting such reduction to low equality with the level ocean, slowly writhe and rise in new highlands as older highlands are worn down, and thus strive to maintain their superior diversity of form, as well as of nearly every other quality, over the uniformity of the ocean.

The atmosphere, dampened by the addition of water vapor from the ocean, is an effective collaborator in this scheme of things; first, in that it gives forth its store of vapor as rain or snow in great abundance and frequency wherever the continents venture to raise their mountain ranges highest; second, in that the dampened air occasions the superficial disintegration or weathering of the continental rock masses, for it is the rock waste thus loosened that the streams of the land sweep down to the sea; third, in that, quite apart from the work of running streams, the weathered rock waste is superficially washed downhill by rainstorm rills, and also that weather changes from wet to dry and from warm to cold cause the rock waste

to a depth of several feet to creep slowly down every slope toward and eventually to reach the stream below: hence in this long-range view of the earth's affairs, all the rock waste of the lands should be envisaged as in slow motion on its way to the sea.

The streams of the land are the most active agents in the great task of smoothing down the continental highlands to ocean level; and admirable engineers the streams are, for they grade their valley floors to a nicety with regard to the work that they have to do. The largest rivers reduce their courses to a gentle declivity; indeed, to just such a declivity as will give them a velocity sufficient to sweep along the rock waste, mostly fine-grained, that is delivered to them by their headwater brooks; and the headwater brooks retain a greater declivity, so that, in spite of their small volume, they shall have a velocity sufficient to wash down the rock waste, often of coarse texture, that is delivered to them from the valley-side slopes.

Be it noted that in this scheme of things, which presumably began its operation long ago in the history of the earth, all the life of the lands depends directly or indirectly, in its struggle for existence, on that part of the weathered rock waste which, in its relation to plant roots, is called soil. The rock waste would undoubtedly be impelled to continue its slow motion from the lands to the sea even if there were no plants to live on it; but plants could not live on the lands if there were no weathered soil to grow in. The plants of the land may, therefore, be regarded as taking advantage, for their own purposes, of the weathering device by which the atmosphere, in its coöperation with the ocean, crumbles the rocks preparatory to their being swept seaward by ocean-fed rivers. Even the trees of mountain-side forests, slowly as their successive generations follow one another, may be conceived as floating on the extremely slow soil current which, as the earth itself looks at these superficial changes, is continually flowing off the lands.

The ocean has plenty of space in which to deposit the waste of the land swept in by the rivers, as well as that worn from the shores by the waves; but the land waste that is delivered in solution is treated very differently from that delivered in suspension. The suspended waste, chiefly gravel, sand, and clay, is spread out in successive layers or strata near the shore, where its accumulation forms the so-called continental shelves, of very gradual slope to depths of forty or fifty fathoms and of somewhat steeper pitch to greater depths. It is these shallow-water strata, in which siliceous, argillaceous, and calcareous deposits are found, that are often restored to the continents, as when an upheaval reveals them in coastal plains, or as when deformational forces crumple them in new mountain ranges. On the other hand, the dissolved substances are, as already stated, uniformly spread through the entire ocean, and there they would remain indefinitely, slowly increasing, if it were not for two very unlike processes by which some of them are withdrawn.

It occasionally happens that an arm of the sea is cut off by an upwarping of the ocean bottom; and if the lands by which the sea arm is enclosed have a dry climate, the enclosed sea water may be evaporated away slowly and its dissolved salts will then be precipitated. Thus, it is supposed, beds of rock salt have been formed; but this process is so exceptional that salt is still the mo t

abundant dissolved substance in ocean water. On the other hand, it happens that another dissolved substance, limestone, continually brought in solution from the lands to the oceans, has been adopted by many marine organisms as the chief component of their solid framework, and it is therefore continually withdrawn to satisfy their needs. Thus mollusks and other creatures, living mostly on the continental shelves but also at greater depths, secrete the dissolved limestone to make their shells. Their remains constitute the calcareous strata of continental shelves above alluded to, particularly near low coasts, where the supply of sandy and muddy detritus from the lands is small. More important are the minute Foraminifera—*Globigerina* being one of the commonest genera—which float near the surface, and the delicate shells of which, sinking after the occupant's death, constitute the greater part of the wide-spread calcareous ooze, or yield a small undissolved residue to form the red clay of the greater depths, as already described. Remarkable also, but less widespread, are the reef-building corals which, together with limestone-secreting algæ and other organisms, thrive in the shallow waters of the torrid zone, either near continents, as along northeastern Australia, or around oceanic islands, mostly volcanic, as in Fiji, or in the open ocean, as through to the Central Pacific. They construct fringing reefs of gray limestone, attached to the land, or barrier reefs rising offshore and enclosing a lagoon, or most extraordinary of all, atoll reefs, in which the lagoon has no central island remaining. The wonderful nature of these structures and the various explanations that have been suggested for them would require a special article for the telling.

The red clays and the calcareous ooze deserve a further paragraph in explanation of their contrasts with the littoral deposits on continental shelves, and of their geologic relations. In the first place, the continental shelves are the depositaries of nearly all of the silica and most of the clay that is washed from the lands, but of only the smaller part of the dissolved limestone; the deep oceans are the depositaries of the greater part of the limestone and of a smaller part of the clay; the little silica that reaches them is chiefly withdrawn from solution by the microscopic plants known as diatoms, the remains of which are found chiefly in the far southern oceans. In the second place, the limestone that is deposited on the shelves may be returned to the continents by upheaval and then may be carried back to the oceans in solution, thus being available for organic use over and over again; but the deep-sea calcareous ooze is a relatively permanent acquisition of the ocean floor; hence the supply of limestone in solution in the ocean would in time be depleted if it were not renewed from calcareous minerals in the older fundamental rocks of the earth's crust and in the lavas outpoured from volcanic vents, which thus for the first time experience superficial analysis. Whether the processes of renewal are now gaining on the processes of depletion, who shall say!

In the third place, the deposits of the continental shelves are of relatively rapid accumulation in varying composition and great thickness and with well-defined stratification under the active processes and fluctuating conditions that prevail near the coasts. Here the successive thinner and thicker layers record every tick of a second and every striking hour in the passage of geological time; but the deep-sea

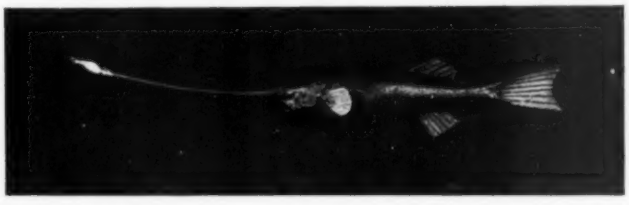
deposits are accumulated in slow and uniform continuity, with hardly perceptible changes of composition from millenium to millenium and presumably without stratification. They record, therefore, only the patient passage of pelagic eternity, in which there is no ticking of the seconds, no striking of the hours, and in which time simply goes evenly and endlessly on. And yet these monotonous, deep-ocean deposits, accumulating in everlasting uniformity, must as they approach the coasts merge into the much heavier and more variable contemporaneous deposits of the continental shelves, which vary from place to place, and from time to time. What a boon it would be to geological science if the on-shore deposits, in which every different stretch of a coast records the passage of its own chapter of time in its own particular fashion and in which unlike strata and fossils are laid down on different coasts at the same time, could be correlated with and dated by the corresponding portion of the steady-going, deep-ocean deposits, and thus given their proper place in a standard chronology of earth history!

The activity of marine organisms in connection with the formation of pelagic deposits brings us to the great chapter of oceanic life which properly belongs in another article by another writer, but which may be here briefly touched upon in its physical relations and in their contrasts with the physical relations of life on land. Let it be recalled, therefore, first, that all the animal life of lands depends for its sustenance, directly or indirectly, upon plant life; second, that all terrestrial plants derive their sustenance chiefly from the carbon dioxide of the atmosphere, which they take in through their leaves and decompose with the aid of sunlight; also that in their competition for this sustenance many land plants have developed self-supporting stems or trunks, which hold them up a little way in the air; third, that all terrestrial animals and plants derive the energy needed for their life work by combining a part of their organic substance with atmospheric oxygen in the continuous process of respiration, a slow process in plants, more active in animals; fourth, that land plants are prevailingly rooted in weathered rock or soil, partly because their chief sustenance comes to them in the ever-moving air, partly because a minute mineral constituent dissolved in ground water, must be brought up from the soil; but land animals are rarely rooted; they must move about in search of food, and in doing so most of them must support their weight while walking, running, or flying; when they are fatigued, they lie down or perch to rest.

So again in the oceans, all animal life depends directly or indirectly on plant life. Second, marine plants, commonly known as seaweeds, derive the carbon dioxide for their sustenance, and both sea plants and sea animals derive the free oxygen for their respiration, from a supply of those atmospheric gases that is dissolved in the ocean water; and the occurrence of animal life in the deep ocean as well as the low temperature prevailing there prove the vertical circulation of the ocean waters, for without such a circulation the supply of free oxygen would have been exhausted long ago and the deep oceans would be dead. This free oxygen must not be confounded, however, with the oxygen that is chemically combined with hydrogen to form ocean water, and the marine animals here

mentioned must not be understood to include those air-breathing aquatic mammals, like seals and whales, which appear to be derived from land quadrupeds, modified for marine existence. Third, as the assimilation of carbon from carbon dioxide demands the aid of sunlight, marine plants live only in shallow water and at the surface of the ocean: the deep ocean has no flora; but as if partly to make up for this lack, the frigid oceans have littoral thickets of seaweeds at latitudes higher than those in which land plants can flourish on the continents. Fourth, unlike land plants which support themselves in the non-supporting air, seaweeds are supported by the water in which they grow; hence those that live in very shallow waters rise to their full height at high tide, and lie down, as if to rest, when the tide is "out." Finally, nearly all marine plants—but not the microscopic diatoms—and also a vast number of marine animals are "rooted," in the sense of being attached to the sea bottom, not because they gain nutriment from their attachment, but because all the nutriment they need is brought to them, often in microscopic doses, in the moving water; they do not have to go in search of it, but they have to search through a great deal of water to obtain as much food as they need. But another large number of marine animals, large, small, and minute, chiefly living at small depths in the open ocean, are free swimmers, and as they have the same average density as seawater, they float at ease: hence they do not know the fatigue of supporting their own weight, nor do they need to lie down to rest.

As to the deep sea, modern exploration has shown that it is not lifeless, as was formerly supposed, but that it has a varied and fairly abundant fauna, in spite of the monotony of existence where there is no variety to give life its spice. Perhaps the most marked physical characteristic of the deep-sea creatures is their ability to withstand the enormous pressure exerted by the overlying water; but they do this in much the same way as we land-dwellers withstand the pressure of the atmosphere; that is, by admitting the surrounding fluid within their bodies and through and through their tissues. Great as the pressure is at the ocean bottom, the mobility of the compressed water is so perfect that a delicate fin or slender tentacle can move through it. Finally, it remains to be said that the great volume of the ocean, between the well populated surface waters and the more scantily populated bottom, is almost lifeless; thus another element, that of dead monotony, is added to its darkness, its cold, and its quietness: it is a vast desert.



Gigantactis vanhoeffeni, one of the inhabitants of the deep sea, dwelling at depths of from 1 to 1½ miles.—The light at the end of the long rod extending from its snout serves, it is believed, as a lure to attract prey. (Approximately life size)

THE NORTHERN ELEPHANT SEAL GROUP, AMERICAN MUSEUM

This photograph shows the dominant elements in the group made possible through the generosity of Mr. Arthur Curtiss James. The bull with head raised was mounted by Mr. Frederick Blaschke; the other specimens by Mr. Clyde L. Patch. The background was painted by Mr. Albert Operti from the photograph of the seal rookery shown on page 572. The

This photograph shows the dominant elements in the group made possible through the generosity of Mr. Arthur Curtiss James. The bull with head raised was mounted by Mr. Frederick Blaschke; the other specimens by Mr. Clyde L. Patch. The background was painted by Mr. Albert Operti, from the photograph of the seal rookery shown on page 572. The

The Northern Elephant Seal and the Guadalupe Fur Seal

By CHARLES HASKINS TOWNSEND
Director of the New York Aquarium

THERE are two species of seals native to the west coast of North America that in the past were harassed with reckless disregard of their possible extinction: the northern elephant seal (*Mirounga angustirostris*) and the Guadalupe fur seal (*Arctocephalus townsendi*). The former, as the result of freedom from molestation during recent years, is at present slowly increasing in numbers; the latter may be extinct, as it has not been seen since 1894, when several seals were killed for their pelts.

The fur seal is known to science only from the weatherworn skulls obtained by the writer at Guadalupe Island in May, 1892.[1] Of the few fur seals seen afloat at that time not one was secured, and none was seen on land during a prolonged examination of their former haunts, although a search was made of all the beach caves around the island.

There is a possibility, however, that stragglers of this species still exist, as the habit of this seal of lying in caves serves to keep it out of sight. Our hunt through the numerous caves of Guadalupe Island in May was futile, doubtless because it was made in advance of the breeding season, which occurs in June and July. We looked for the animal again in March, 1911, during the expedition of the "Albatross,"[2] but did not examine the caves, believing it useless to do so at that time of year. Any further search should be made late in July, before the young take to the water, and should include all the caves along the water line. The hope that, if still surviving, it may reestablish itself, is reënforced by the fact that Guadalupe Island is now a guarded reservation. This valuable seal formerly inhabited the islands of Lower California and those of California northward as far as the latitude of San Francisco. In 1892 the writer secured from men who had participated in sealing at Guadalupe and the San Benito islands certain records which, supplemented by researches he made subsequently at San Diego, indicate that 5575 fur seals were taken between 1876 and 1894.

To the records of fur seals known to have been killed by sealers at Guadalupe, San Benito, and Cedros (Cerros) islands, may be added figures which the writer found recently in the third edition of William Mariner's account of the Tonga Islands, published in London in 1827.[3] Mr. Mariner was on board the British whaler "Port-au-Prince," which took 8338 fur-seal skins at Cedros, San Benito, and Guadalupe islands, between August 1 and September 19, 1806. Another record is that of the ship "Dromio" of Boston in 1807, which at "Shelvock's Island," alleged to be southwest of Cape San Lucas in latitude 21°, "in a fortnight killed 3000 fur seals." Belcher (1837)

[1] Townsend, C. H. 1899. "Pelagic Sealing." Extract from *The Fur Seals and Fur-Seal Islands of the North Pacific Ocean*, Part III, pp. 223–74.

[2] This old ship, after a long and eventful career, has recently passed into private ownership. Its record of service is commemorated in a Note contributed to this issue by Doctor Townsend (p. 619).

[3] Mariner, W. 1827. *An Account of the Natives of the Tonga Islands, in the South Pacific Ocean.*

THE "ALBATROSS" DREDGING AT SEA

The dredging boom may be seen out to starbord; the port boom is rigged for surface towing. The "Albatross," after nearly four decades in the service of the government, in the course of which she participated in a number of important scientific expeditions, recently passed into private ownership. (See Note on p. 619 of this issue)

and others failed to find "Shelvock's Island" in the position described. It may have been Guadalupe Island, farther to the north, but whatever its identity, in this region the species taken must have been the Guadalupe fur seal. While the scattered records of the long-continued hunting of the Guadalupe seal account for large numbers, Mariner's statement and the record of the "Dromio," so long overlooked, seem to indicate that the species may have been much more abundant than has hitherto been supposed. There is further reason for this inference in the fact that the islands where the species—of the same genus as the Antarctic species—developed, remained unexploited until whaling in North Pacific waters began late in the eighteenth century. Dr. E. C. Starks[1] has shown conclusively that the great numbers of fur seals killed on the Farallon Islands, off the coast of California, during the earlier years of the nineteenth century were of this species.

While the very existence of the Guadalupe fur seal is in doubt, the preservation of the elephant seal seems assured. As a result of representations made to the Mexican government after the re-discovery of this seal in March, 1911, by the "Albatross" Expedition and again by the joint American and Mexican party of biologists[2] that visited the island in the Mexican patrol boat "Tecate" in July, 1922, Guadalupe Island was made a reservation and provided with a resident guard.

The expedition of the "Tecate" found 264 elephant seals at Guadalupe—more than twice the number counted by the writer in 1911—and from a study of the old and young estimated the size of the herd, present and absent, at about 1000 animals.[3]

The casual reappearance of the elephant seal at other islands, from Cedros northward to the Santa Barbara Islands, may reasonably be expected. As the protection now afforded by the Mexican government is limited to Guadalupe Island, the animal may not find very safe quarters when it extends its present range. It is, therefore, desirable that precautions be taken to insure the safety of such stragglers as may appear among islands of the Santa Barbara group, where in the absence of restrictions it is liable to molestation by fishermen. The elephant seal should be given the fullest opportunity to return to its ancient haunts north of the boundary. It is not only commercially valuable but also inoffensive and of great scientific interest.

The ancestors of the northern elephant seal, like those of its associate in habitat, the Guadalupe fur seal, wandered from Antarctic waters and successfully ventured across the equatorial barrier in times sufficiently remote to have enabled their descendants to acquire new characters in a strange environment. The account of the northern elephant seal, published by Scammon[4] in 1874, continued for many years to be the main source of information respecting the creature. Only a few immature specimens were to be found in museums, and naturalists assumed that t had become extinct. Much more is known about the Antarctic species.

[1]Starks, E. C. 1922. "Records of the Capture of Fur Seals on Land in California," *California Fish and Game*, Vol. VIII, pp. 15–60.

[2]Hanna, G. Dallas, and Anthony, A. W. 1923. "A Cruise Among Desert Islands," *National Geographic Magazine*, Vol. XLIV, No. 1, pp. 71–99.

[3]For an account of the status of the herd in 1923 the reader is referred to the article by Mr. Huey in this issue.

[4]Scammon, Charles M. 1874. "The Sea Elephant," *The Marine Mammals of the North-Western Coast of North America*, pp. 115–23.

The discovery of a small herd at San Cristobal Bay, Lower California, in 1880, created an immediate revival of sealing, which resulted in the killing of more than three hundred animals during the next four years. These facts were reported to the National Museum in 1884 by the writer, who thereupon was sent at once in a chartered vessel, the schooner "Laura," in search of specimens. Sixteen seals—all that were found during a cruise of two months—were taken for scientific purposes, as the only alternative to their slaughter by sealers.[1]

The elephant seal was then lost sight of for nearly a decade. In 1892 a small band was found at Guadalupe Island by the writer while in search of fur seals under the direction of the Department of State. Some of these elephant seals were secured and the identity of the fur seal—the object of the expedition—was established.

From 1892 information respecting the elephant seal was lacking, so far as biologists were aware, until 1907, when Guadalupe Island, long uninhabited, was visited by Charles Harris in the interest of the Rothschild Museum.[2] There about forty of the animals were found.

The next important event in this history of the northern elephant seal was the visit of the "Albatross" to Guadalupe Island in 1911. Thanks to the generosity of Mr. Arthur Curtiss James, of New York, the American Museum of Natural History had the privilege of coöperating in this expedition, as a result of which the Museum obtained its splendid habitat group of these huge animals. Much descriptive and pictorial material, previously lacking, was also secured. The numerous photographs were, indeed, the only ones of the elephant seal that had until then been taken, with the exception of a few made by Harris in 1907 at the same island. Six young elephant seals captured by this expedition were exhibited at the New York Aquarium, where some of them lived nearly two years. These are now preserved as specimens in the American Museum, the United States National Museum, and the Brooklyn Museum.

In 1922 the expedition of the "Tecate" to Guadalupe took place, to be followed a year later by a second visit of this ship to the island.

Having given this brief summary of recent expeditions concerned with the elephant seal, let us cast our eye back over some of the earlier narratives. In Mariner's account referred to above, it is stated that the "Port-au-Prince" was proceeding to "the island of Ceros" (Cedros) for the purpose of "laying in a cargo of elephant oil and seal-skins" but the account contains no further reference to the elephant seal which, it is known, was abundant there at that time (1806).

Scammon,[3] in writing of the animal life at Cedros Island, says, "Seals and sea-elephants once basked upon the shores of this isolated spot in vast numbers, and in years past its surrounding shores teemed with sealers, seal elephant, and sea-otter hunters. . . . But those innumerable herds of sea-elephants have long since been nearly exterminated, and here seals likewise are found only in comparatively small numbers."

Scammon states that the elephant

[1]Townsend, C. H. 1885. "An Account of Recent Captures of the California Sea Elephant and Statistics Relating to the Present Abundance of the Species." *Proc. U. S. N. M.*, pp. 90–4.

[2]Rothschild, Hon. Walter, Ph.D. 1908. "Mirounga angustirostris (Gill)," *Novitates Zoologicæ*, Vol. XV, p. 393.

[3]Scammon, C. M. 1869. "Report of Captain C. M. Scammon, of the U. S. Revenue Service, on the West Coast of Lower California." Appendix, pp. 123–31, of *Resources of the Pacific Slope*, by J. Ross Browne.

seals come to shore at certain seasons of the year to shed their coats and to give birth to their young. He tells of the method of hunting: how the seals ashore were driven farther landward by men advancing from the water to slaughter them. Their number in the days of which he speaks was great enough to give "full cargoes to the oil-ships." The smaller animals were killed by clubbing, the large males by shooting. There is considerable evidence that the former abundance of the elephant seal in the Lower California region has not been overestimated.

Many whalers and sealers frequented the shores and islands of Lower California between 1808 and 1840 under American, British, French, and Russian flags, and it is known that the elephant seal was much hunted for a few years after the discovery of gold in California and that, as a consequence, it became scarce.

Except for some recent observations by members of the "Tecate" expeditions,[1] the natural history of the northern elephant seal apparently is recorded only in the writings of Scammon[2] and the reports of the "Albatross"[3] expedition. Rothschild's remarks on the specimens collected by Harris are limited to a single page. Scammon's descriptions deal largely with the Antarctic elephant-seal fishery.

The northern elephant seal is the largest of all seals, with the possible exception of the Antarctic species, an extremely large specimen of the former measuring, according to Scammon, twenty-four feet in length. The same author refers to one twenty-two feet long which yielded 210 gallons of oil. The three large males taken by the "Albatross" Expedition at Guadalupe Island in 1911 were each sixteen feet in length. During the past half-century the northern species has had little chance of attaining large size. Under the protection now afforded, it is possible that *monsters* twenty feet or more in length may reappear at Guadalupe Island. The writer found the blubber of the three males mentioned to be four inches thick about the fore part of the body. Cleveland says that the fat of the Antarctic species, taken by him at Kerguelen Island, was seven inches thick and that the largest specimen might yield as much as 245 gallons of oil, while Murphy[4] indicates a maximum of about eight inches for the blubber. As the oil is superior to whale oil for lubricating purposes, there can be no doubt about the great value of the elephant seal as an oil producer.

Few large animals are so indifferent to the presence of man as these great seals. They showed little inclination to move as members of the "Albatross" Expedition walked among them. When intentionally disturbed, they soon quieted down, often throwing sand on their backs with their flippers and completely ignoring our presence. Even when roughly prodded and forced into the sea, they usually returned promptly. While in the water, they were equally unconcerned about the coming and going of the ship's boats. A common attitude in the water, especially with those of smaller size, is to float with only the nose and hind flippers above the surface.

Getting out of the water is difficult

[1]Hanna, G. Dallas, and Anthony, A. W. 1923. "A Cruise Among Desert Islands." *National Geographic Magazine*, Vol. XLIV, No. 1, pp. 71–99. Also Anthony, A. W. 1924. "Notes on the Present Status of the Northern Elephant Seal, Mirounga Angustirostris," *Journal of Mammalogy*, Vol. V, No. 3, pp. 145–52.

[2]Scammon, Charles M. 1874. "The Sea Elephant," *The Marine Mammals of the North-Western Coast of North America*, pp. 115–23.

[3]Townsend, C. H. 1912. "The Northern Elephant Seal." *Zoologica*, Vol. I, No. 8, pp. 159–73.

[4]Murphy, R. C. 1918. "The Status of Sealing in the Sub-Antarctic Atlantic." *The Scientific Monthly*, August, 1918.

View of the northern end of the elephant seal rookery on Guadalupe Island.—Males, females, two-year-olds, and yearlings are lying about on the beach. The two males in the middle distance with heads erected are in fighting attitude, the proboscis being retracted and the mouth wide open. In the distance is seen the "Albatross." This photograph suggested the background for the Elephant Seal Group shown on p. 566

The old males are usually sleepy and disinclined to move unless forcibly disturbed

Adult male and female elephant seals.—The male assumes a threatening attitude only when deliberately aroused

The calloused surface in front is the result of fighting.—This part of the body is often deeply scarred and unsightly

for such heavy-bodied and short-limbed animals. In passing through the shallow water the hind flippers are raised and spread to take advantage of the pushing effect of the low waves.

When the creatures are on the dry beach, progress is still slower, but under crowded conditions individuals have actually crawled inland several hundred yards. In moving up the beach the animal arches its back and, rising on the fore flippers, draws the hind quarters forward. Its progress is interrupted by frequent pauses.

During the mating season the large males engage in considerable fighting, especially those accompanying females. When within striking distance of each other, they rise as high as possible on the fore limbs, draw the flabby proboscis into folds on top of the head, which is held aloft, and strike quick blows at each other's necks and shoulders with their large canines. The attacks are accompanied by considerable nasal and vocal noise. The animals of fighting age and size bear the marks of many previous encounters, the skin of the neck and breast being rough, calloused, and hairless as a result of the punishment received from adversaries.

The fighter makes little attempt to protect his fore quarters, which seem to serve as a shield for receiving blows; but he is careful to strike quickly and withdraw his precious nose out of harm's way. There is apparently no actual seizing and tearing of the skin, the offensive blow being a quick bite with the large canines. The combatants soon separate; there is none of the prolonged tussling and fierce scrimmaging indulged in by male fur seals, which often leave them with gaping wounds. A fur-seal fight is of the dog-fight sort.

The proboscis of the elephant seal, relaxed and pendent when the animal is crawling, or lying in a flabby mass when the animal is at rest, is capable of many muscular expressions when the seal is awake and moving about. It may be withdrawn and wrinkled up in various positions on the head, or if the head be thrown back completely, may hang relaxed toward the rear.

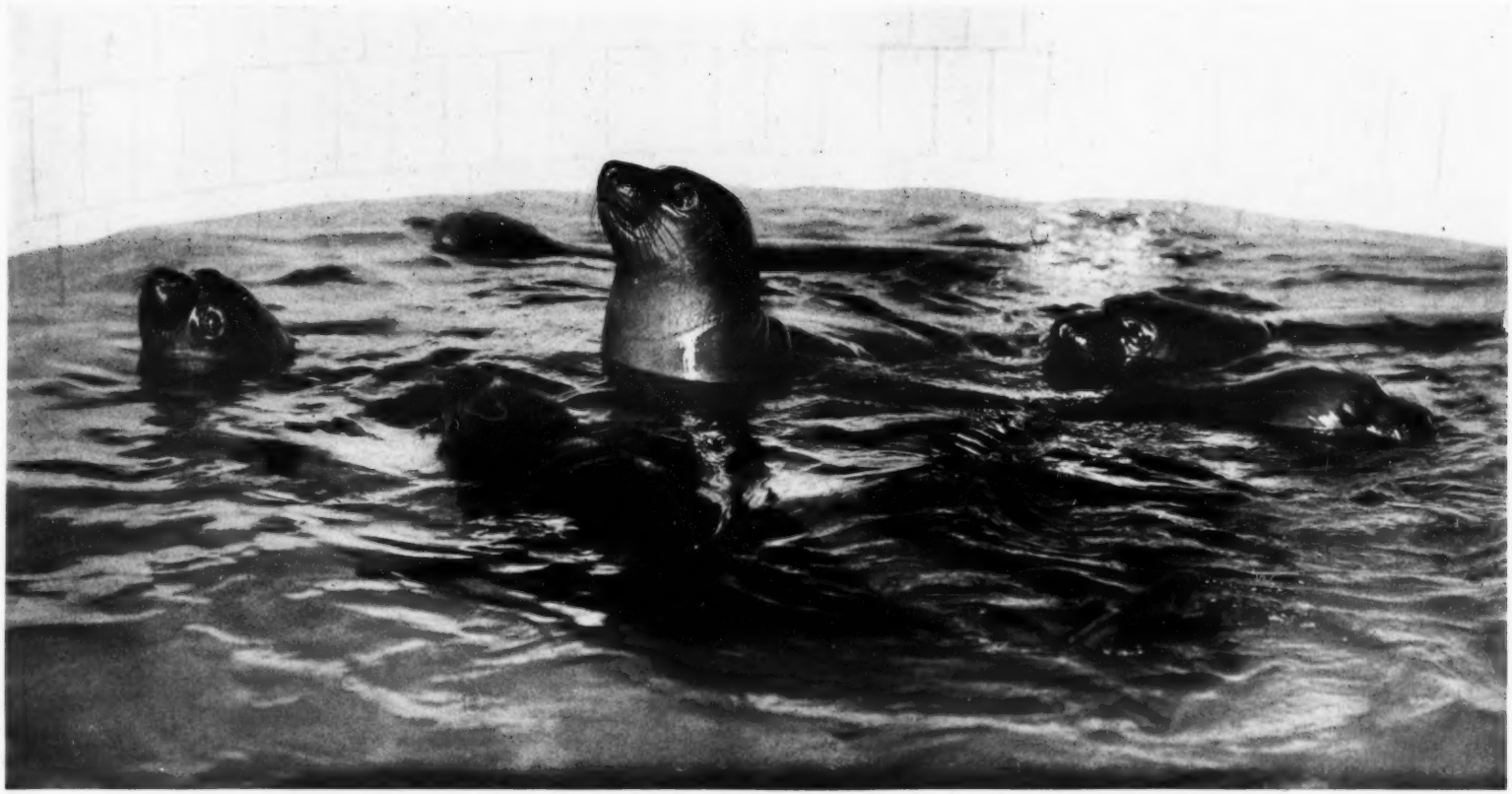
The proboscis is only slightly developed in the half-grown males, suggesting that it does not become fully developed until sexual maturity is reached. In the females the proboscis is lacking. Anatomical study of the proboscis is desirable, as there is uncertainty whether it really can be "inflated." During the skinning operations of the "Albatross" Expedition no inflatable air sacs, or chambers, were noted, but it is possible that such may have been overlooked.

The very young elephant seal is black and is so excessively fat as to be almost helpless. The yearling is grayish brown in color, and is about four feet in length. None of the six yearlings brought to the New York Aquarium was more than five feet long. In weight they varied from 167 to 301 pounds, the males being heavier than the females. Their capture was effected by simply rolling them separately in nets and lifting them into the boats. They showed no inclination to bite when on the beach, on the deck of the "Albatross," or during their life at the Aquarium, although when approached, they would assume a threatening attitude by opening the mouth very widely.

Nothing very definite is known regarding the feeding habits of this seal. In the stomachs of those killed at various times the writer found nothing but a little sand. It is stated in some of

The bulky object on the beach in front of the boat is a young seal rolled up in a net to render it helpless. Thus secured, it was rowed to the "Albatross" and with five of its fellows started on the long journey to New York

Yearling elephant seals in the pen especially constructed for them on the deck of the "Albatross"



SIX YEARLING ELEPHANT SEALS IN THE NEW YORK AQUARIUM
The greater number of them lived for nearly two years after taking up their abode in the institution at Battery Park

the accounts of the Antarctic species that seaweed and the remains of squid have been noted in the stomachs of these seals. Murphy found, in addition to squid, the remains of small fish in the stomachs of animals killed as soon as they had come to shore.[1] Harris observed "tiny sardines not more than two inches long" in his Guadalupe specimens. Anthony[2] alludes to the capture of a young male, three-quarters grown, "which had recently bolted a bass of about two pounds weight." He adds that "a few fragments of kelp, taken perhaps at the same time as the fish, and a few pebbles were the only stomach contents." The yearlings brought to the Aquarium ate nothing but fresh fish. Usually this food was given them cut into pieces, but they preferred the live fish that were occasionally supplied. The daily ration for each of the seals was six or seven pounds of smelt, tomcods, roach, and cod. They ignored absolutely squid, live crabs, and seaweed. Unlike most seals, they crushed their food before swallowing it, often turning on their backs in the water during the process of mastication. They would take the food from the hands of their keeper with no signs of fear.

In swimming about the large pool the fore flippers seldom came into action, the hind flippers being employed much as a fish uses its tail. These young elephant seals often slept under water, stretched out on the floor of the pool.

It is possible that the elephant seal is more active at night than by day. It may be that it feeds only at night, which would account for the lack of evidence as to the food of those killed in the daytime. Its eyes are suggestive of those of nocturnal animals, being remarkably large, dark, and lustrous.

Although the elephant seal apparently does not wander far from shore, like the fur seal and some other species, it has at least one enemy in the shark. A specimen secured by the writer at San Cristobal Bay was disfigured by a gash on the rump in which were the marks of a shark's teeth. Sealers told the writer that fully one fourth of the smaller animals captured there bore such marks.

The total number of elephant seals killed during the past forty years at San Cristobal Bay and Guadalupe Island—the only places they were known to frequent during that period—appears to have been 454. Since 1884 none has been found at San Cristobal.

Comparison of the large skulls secured in 1911 at Guadalupe with those of the Antarctic species has shown the distinctness of the northern species. This is also apparent when the excellent photographs now available of living animals of both species are compared.

Naturalists have not seen enough of the northern elephant seal to determine whether it is polygamous to the extent of the southern species. It is evident that much remains to be ascertained in regard to this interesting mammal before its complete life history can be written.

[1] Murphy, R. C. 1914. "Notes on the Sea Elephant, *Mirounga leonina* (Linné)." *Bulletin, Amer. Mus. Nat. Hist.*, Vol. XXXIII, pp. 63–79.

[2] Anthony, A. W. 1924. "Notes on the Present Status of the Northern Elephant Seal." *Journal of Mammalogy*, Vol. V, No. 3, pp. 145–52.

A WARD OF GUADALUPE ISLAND

In 1922 the island of Guadalupe was declared a government reservation by the authorities of Mexico City, and it is to be hoped its elephant seal population will escape in the future the persecution to which it was subjected in the past

A Trip to Guadalupe, the Isle of My Boyhood Dreams[1]

By LAURENCE M. HUEY
Curator of Birds and Mammals, Natural History Museum, Balboa Park, San Diego, California

NOTE.—The preceding paper, recording the visit of the "Albatross" to Guadalupe in 1911, will have whetted the reader's interest for an article dealing with the later history of the herd of sea elephants. The main purpose of the expedition of 1923 in which Mr. Huey participated was to take a census of these animals. They had then been enjoying government protection for about a year and their number had increased from 264—the total counted by members of the coöperative expedition in July, 1922,—to 366.

Since preparing the present article, Mr. Huey has again visited Guadalupe and spent the day of August 30, 1924, on the elephant seal beach. He writes that, at that time, the count showed but 124 animals, of which only 9 were large adults. The majority were of intermediate size and there were 6 yearlings. Whether the fluctuations in the beach census of the past three summers reflect with any accuracy the relative abundance of the total living elephant seals cannot, in the judgment of Mr. Huey, yet be determined. He feels that these facts depend upon a much greater knowledge of the movements, breeding habits, and food of the elephant seal than has as yet been secured.

IT had been a restless night despite the quiet sea and the even roll of the boat, for the long-hoped-for trip to Guadalupe, the island of my boyhood dreams, was really taking place. In the early gray of dawn, I was on the bridge peering into the west with the hope of seeing the dim outline of the enchanted isle. During my early boyhood, while wandering about the water front of San Diego, I had heard many tales of this out-of-the-way island, which lies off the Mexican coast about 180 miles southwest of San Diego, and that I was now actually on my way to it was due to the courtesy of the Mexican government. I had been invited to join a party in charge of Prof. J. M. Gallegos, of the National Museum of Natural History, Mexico City, that was planning to visit the island. The voyage was made aboard the Mexican Fisheries Patrol Boat "Tecate," which started from San Diego on July 10, 1923, and, after touching at Ensenada, Lower California, set her course on the open Pacific.

After I had been watching for hours, far to the southwest a dim outline commenced to take shape about eight o'clock in the morning. Finally landmarks began to appear and these were pointed out to me by different members of the party who were familiar with the place. As I scanned the rocky slopes, I noticed that moving things were in evidence everywhere—for the island was swarming with goats! It appears that in the old whaling days goats were introduced on Guadalupe as a source of meat and have increased to such an extent that they now completely overrun it. At this season, when everything was dry, they were invading the sheer faces of the cliffs in search of some stray bit of lichen or moss on which to feed. We marveled at their agility and their ability to cling to the precipices—almost as tenaciously as a fly ascending a windowpane. However, their adventures were not without peril, for, while we were steaming slowly near the shore, searching for a suit-

[1]Photographs by the author.

able anchorage, we saw several carcasses of goats floating in the water,—an evidence that the animals had fallen from the bluffs which overhang the sea.

Our anchorage was made within fifty yards of the east shore of the island, near the site of the old penal colony that is today occupied by a garrison of soldiers, placed there to guard the surviving elephant seals (*Mirounga angustirostris*), which inhabit a small beach on the opposite side of the island. These animals were brought to the very brink of extermination by the old whalers, who sought them for their oil, which before the days of petroleum was used extensively by the gold hunters of California for lighting. The small herd which exists on Guadalupe Island comprises the only representatives of this species now upon the earth. As a result of a coöperative expedition made in the summer of 1922, this rugged island, which is only 20 miles long and 6 miles wide, was created a federal reserve by proclamation of the Mexican government.

It was with no little interest that we landed in the late afternoon. With another member of the party, I set out and explored a cañon for half a mile inland. A rocky, rugged waste it proved to be, with reeking carcasses of goats scattered about in various stages of decomposition. The narrow cañon was at times nearly stifling due to the heat of the reflected rocks, and there was no breeze to stir the air. We saw but two species of birds, the Guadalupe rock wren (*Salpinctes guadeloupensis*) and the Guadalupe house finch (*Carpodacus amplus*). Both these birds proved fairly abundant. They might be seen

The houses of the old penal colony, with a sign posted on the officers' quarters proclaiming in both Spanish and English that, by presidential decree, the killing or capturing of elephant seals is prohibited

in a small flock or family searching for maggots in the carcass of some dead goat.

The eastern sky was cloudless next morning, and the sun rose in almost tropical splendor. Professor Gallegos and I were landed through the surf with our lunch, guns, and cameras, for this day had been designated as the one on which the top of the island was to be explored. A boy and pack burro were placed at our disposal by the commander of the garrison. As we gained altitude on the steep and rocky trail, a grand view of the northern end of the island was spread before us, while banks of fog were swept over the northern head by the incessant western winds.

On reaching the floor of a small valley, I was much impressed by its desolation. Not even a spear of dry grass was to be found among the rocks, and only one or two green bushes could be seen hanging by their strong roots from crevices in precipitous cliffs—out of the reach of the ravenous goats. Though safe from destruction, these bushes were not unobserved, for well-traveled goat trails led to the cliffs both above and below them, where the shaggy beasts had evidently been feasting with their eyes if not with their teeth. About half a mile from the spring, which is situated on the eastern slope of the island near the summit, was found what had been part of Guadalupe's beautiful cypress forest, but which consisted now only of dried, naked tree trunks. This was another result of the ravages of the ubiquitous goats; for when the season of the annual grasses has passed each year, the beasts resort to the bark on the trees, and are fast devastating the small forests which crown the island.

Arriving at the spring, we quenched our thirst at a pool that had been safely fenced from pollution and were pleasantly surprised at the quality of the water. A question that naturally occurred was why the spring should be located so near the crest of the high slopes. Investigation of the rock strata told the story. The water came from the forests above, on the westward slope of the island, which were continually drenched in fog. The moisture, condensing and dripping to the ground from the leaves of the trees, is concentrated by strata of hard rock which slope gently through to this point on the eastern side of the island. These strata are impervious to water, and thus carry the moisture to the outcropping where the spring occurs. Through this agency alone is life able to exist on this desolate island. Eventually the goats themselves will be their own undoing, for with the passing of the forests—which is inevitable—the water supply will also cease to be, and with it will disappear the terrestrial life on the island.

Of ten species of birds and mammals which have been recorded as endemic on this island,—namely the Guadalupe fur seal (*Arctocephalus townsendi*), the Guadalupe wren (*Thryomanes brevicauda*), the Guadalupe towhee (*Pipilo consobrinus*), the Guadalupe caracara (*Polyborus lutosus*), the Guadalupe flicker (*Colaptes rufipileus*), the Guadalupe petrel (*Oceanodroma macrodactyla*), the Guadalupe rock wren (*Salpinctes guadeloupensis*), the Guadalupe house finch (*Carpodacus amplus*), the Guadalupe junco (*Junco insularis*), and the dusky kinglet (*Regulus calendula obscurus*),—the five first named are now gone forever. The goats are responsible for the passing of three of these—the Guadalupe towhee, Guadalupe wren, and Guadalupe caracara. The

If many dry years reduce the annual growth on the island to a minimum, there will be little left of the forests, for the goats gnaw the very bark from the trees, and even climb to the more accessible limbs

towhee and wren were exterminated by the complete destruction of the underbrush by the goats. The caracaras preyed upon the new-born kids and were destroyed by the men who had been granted the concession of exploiting these animals for their hides and tallow, for they thought the birds were limiting the increase of the goats. Thus, indirectly, the goats caused the extermination of the caracara. The flicker was brought to its doom by the introduction of house cats by the early Russian sealers, who also introduced the common house mouse (*Mus musculus musculus*). Both of these animals, in addition to the goats, have run feral over the island, causing untold destruction to the birds and plants. A glance at the barren landscape and bleak, leafless skeletons of the cypress trees through which we passed was sufficient to impress upon us the fact that the end is near for what Dr. Edward Palmer in the seventies described as a naturalist's paradise.

After lunch Professor Gallegos and the pack boy went on to the top of the island to collect specimens of the cypress and take photographs, while I stayed about the spring to observe the birds. I later joined them near the summit and had opportunity for a hasty glance through the forest and for the making of a few pictures. I was much impressed by the appearance presented by the cypresses, for dead, leafless limbs hung to the ground in a thick, inter-locking mass and the goats had tunneled through these masses,

much as meadow mice tunnel in a grassy swamp. In places I saw evidence that the goats had adopted even arboreal tactics, and had climbed well into the trees to gnaw away the bark. Dripping with cypress pitch, the trees presented a sad sight, for their very life blood was oozing away. Nothing but old trees were found in this forest, for the hungry goats do not allow the seeds to sprout. It remains only for the now-existing trees to live out their lives, when this species also will pass away on Guadalupe.

As we made our journey downward in the cool of the late afternoon, goats were seen everywhere journeying toward the spring—from the north, the south, and all directions. I fired my gun toward one large flock to frighten the animals, and they scurried off across the precipitous gullies and were soon out of sight.

At daybreak the next morning we set sail for the beach on the northwest part of the island, where the elephant seals are to be found. As we were approaching toward the north head in the lee of the island, the wind ripped through gaps in the crest and descended in what is known to the mariner as "woolies." Several of these were so violent that the awning on the after-deck of the boat had to be furled, and at times I thought the very rigging would be torn from the masts. After we had passed from the shelter of the island, we were met by a veritable gale and a frothing, heaving sea, which dashed over the ship, causing all of us to seek a seat of safety with a convenient handhold. We were sailing close to the rocky coast, and the towering cliffs, rising like spires into the sky, made an impressive scene. The fog had risen and, as we passed along, we were able to see the summit of the island in its entirety. Now, for the first time, though at a distance, I beheld the rugged pines in their stronghold, struggling for existence on the brink of the precipitous cliffs. Their wind-swept limbs were all stretching to the eastward, for the prevailing western winds would scarcely permit a leaf to face them. The small endemic palms were also noted, fighting for life against the elements and the goats, on the sheltered slopes wherever their existence was possible. Goats were seen everywhere and occasionally a sudden cloud of dust would rise from the faces of the cliffs where, frightened at our approach, the animals had, in the haste of their departure, started an avalance of stones toward the sea.

After we had passed well around to the western side of the island, the sea became reasonably quiet and we all began peering at the shoreline in search of elephant seals. Those of the party who were acquainted with the place called my attention to a loud snorting, which sounded plainly from the shore though we were fully half a mile away. This noise, I was told, was made by the elephant seals.

The long-awaited cove was soon reached and its short, sandy beach seemed covered with the huge beasts. I could hardly wait while the anchor was dropped and the skiff got ready. It required a bit of skilled seamanship to make a safe landing, for the breakers on the west side of the island were swept shoreward violently by the western wind. Once on the beach, I found myself face to face with the huge creatures of the sea. It was with a great deal of timidity at first that I walked in their midst, but I finally ventured to pat one enormous fellow as he lay dozing in the mellow heat of the sun. It amazed me to find that

AN ELEPHANT SEAL THROWING COOLING SAND OVER HIS BACK

the beasts were not only not vicious but allowed us to walk freely among them and to talk to each other without taking alarm. Their sense of hearing seemed to be only slightly developed, but a very few grains of sand kicked over their slumbering faces was sure to arouse them.

The majority of the animals were adult or nearly adult, and there were only five seen that could be classed as yearlings. The whereabouts of the breeding females and "pups" was a mystery.

The difference in the ages of the seals was easily discernible, for the younger individuals were bluish gray while the old ones were of a yellowish cast. The older animals were in a state of moult with the hide peeling, hair and all, from their backs, much as a sunburned bather peels on our pleasure beaches at home. All showed evidences of having fought and their necks, shoulders, and faces were seared by deep scars, made either by the rocks against which they bumped or by their opponents' great canine teeth. However, they seemed placid now as they rested in the sunshine on the beach. It did not apparently matter in their case which side was up—for as many were lying up-side-down as right-side-up—nor whether the left side or the right side was toward the sun, for any part of their round body seemed to flatten enough in the sand for comfort.

After our party had viewed the herd, we made a census of the seals, which totalled 366 individuals. We then walked boldly in their midst, purposely frightening many of them into the water. With no little interest we watched the actions of the beasts, for they ambled to the water almost agilely by the use of their front and rear flippers, making remarkable speed for such heavy animals. Others that were not disturbed flipped sand onto their backs with their front flippers to free their peeling skin from the irritating flies and to protect it against the warm sunshine. One beast that I had under observation for some time, while I was making photographs, used his front flippers much as a person would use his hand, to scratch his side or his nose or any part of his body that was within reach. The action of the digits of the flipper reminded me very much of fingers, especially when the animal was rubbing the more sensitive parts of his nose.

On the second day of our stay at the seal beach, I witnessed a combat from start to finish and was much amused and impressed by the way the animals fight. The combat was provoked by the attempt of one huge beast to get to sea by crawling over the back of his neighbor, who much resented the extra two tons of weight bearing down upon his back. The animals began to grunt and snort, and rose threateningly on their front flippers with their heads erect and their huge cavernous mouths opened menacingly. Near-by seals, realizing what was about to take place, gave room and the battle commenced. The two combatants struggled, neck and neck together, each attempting to bite the other or working for an advantageous position on the sloping beach. These aggressive tactics carried them ever nearer to the surf, and finally they reached the wash of the waves. Here each would endeavor to take advantage of an on-rushing wave as an aid in hurling his bulky body against his antagonist. For fully five minutes they sparred in the surf, until one of them, apparently thinking that discretion was the better part of valor, went into deeper water, where he

AN ELEPHANT SEAL THROWING COOLING SAND OVER HIS BACK

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rolled lazily in the swelling waves, while the other ambled back to his place on the beach.

Our work on the seal beach being finished, we again returned to our anchorage on the eastern shore and the following morning set sail to the southward, steaming as close to the island as possible in the hope that a last remaining Guadalupe fur seal (*Arctocephalus townsendi*) might be discovered. How bleak and barren the landscape appeared as we moved slowly along just beyond the reach of the breakers! Hardly any bird or animal life, excepting goats, was seen, though an occasional dark-mantled western gull (*Larus occidentalis livens*) or Farallon cormorant (*Phalacrocorax auritus albociliatus*) was observed, and a single California sea lion (*Zalophus californianus*) was seen basking in the sunshine on the top of a rock near the water. The tide was low at this morning hour and many flocks of goats were observed at the water's edge nibbling at the kelp. So scarce is food for them on the island that they descend during low tides to feast upon the kelp and they no doubt quench their thirst with salt water. From our vantage point on board ship we were able to study the geological formation of the island. In many places could be seen large craters surrounded by black streams of cold lava that had once been belched forth red-hot from the earth. One area was of cinder red color, as though still aglow with the fiery heat which marked the birth of this island.

Upon rounding the southern end of the island, we saw to our surprise a United States Eagle Boat lying at anchor with the Stars and Stripes floating above the taffrail. As we passed almost within hailing distance, each national emblem was dipped in honor of the other. We proceeded to an anchorage in the quiet waters of South Bay, on the shores of which we found a party of bluejackets with the commanding officer of the Eagle Boat hunting goats to stock their larder. On our cruise around the island we had planned to spend the night at this anchorage, going up the western coast in the morning. There we intended to capture a couple of the smaller elephant seals and to bring them back alive—one for the Zoological Garden in San Diego and the other for Mexico City. Our visit to the seal beach had sadly shaken our hopes of being able to cope with or carry even the smallest of the seals we had observed in the herd. However, when we talked with the commander of the Eagle Boat and found that it was possible to obtain the help of twenty or thirty energetic sailor boys and a vessel of good displacement to bring back the captive seals, our expectations were again revived.

Two fair-sized islets mark the southern end of Guadalupe Island, and as soon as we had rounded these, we were again buffeted by the west winds. How the boat pitched and rocked in this turbulent sea! At times the sweeping spray passed clear over our ship, wetting the decks and everyone on them. During the four-hour journey up the western shore of the island, the Eagle Boat and our craft went bow to bow, and the only event of natural history interest on our journey was the flushing of a few pairs of Xantus' murrelets (*Endomychura hypoleuca*).

We landed at the seal beach and were soon followed by a dozen or more lusty bluejackets in their whaleboat. Theirs was the fiery enthusiasm of

When teased, the seals would open their cavernous mouths and act as though they would like to devour the aggressor with one gulp

It takes more than a single elephant seal to beat a detail of young naval reservists provided they have tackle enough

youth, and action was what they wanted. Accordingly the seals were quickly scattered and driven into the sea when once these boys started to work in their midst. Selecting one of the smallest seals, they tangled him in a large rope cargo net, which was then lashed to a broken oar and carried to the whaleboat. As there was not enough tackle to cope with the second animal, the bluejackets departed from the beach with only one captive.

After all hands were again safely on board, each ship blew three blasts of the whistle as a farewell. The Eagle Boat put out to sea for San Diego and our ship went back to its anchorage near the garrison. Here we spent the night, and departed the next day at noon for Ensenada on our way home. Thus ended the trip of my boyhood dreams to the isle of Guadalupe, and, though there were disappointments, my pleasures were many.

The queer proboscis from which the elephant seal derives its name is here seen to good advantage

The Seal Collection

A FEATURE OF THE HALL OF OCEAN LIFE, AMERICAN MUSEUM

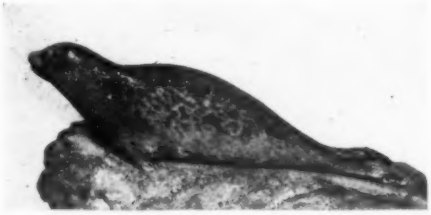
By FREDERIC A. LUCAS

Honorary Director, American Museum

A PROMINENT feature of the Hall of Ocean Life, the construction of which is drawing to completion, will naturally be the seals and their relatives and, while there are gaps that we should like to see filled, yet, when the doors are opened, a goodly portion of the seal population of the world will be represented. Chief among them are—or will be—the groups of sea elephants, Steller's sea lion, and the Alaskan fur seal. The story of the sea elephants is told elsewhere in this issue, the sea lion will be described and figured at some future time, while a picture of the Fur Seal Group must suffice for this account, which is restricted to the general collection of seals.

In poetical parlance it might be said that the series of seals reaches from pole to pole; in plain prose it contains examples from the Arctic to the Antarctic—but they are scattered along at intervals with numerous gaps between. This is partly because seals as a rule occur at widely separated localities, partly because they dwell in places difficult of access, and largely because there have been no definite attempts to collect them. Also there is little attraction in the chase of the seal: where seals are abundant, it is mere slaughter; where they are rare and wary, it is a trial of one's patience. Moreover, seals have this advantage over most animals, they can slip into the water and elude pursuit. Nevertheless, it is to be hoped that friends of the American Museum, seeing this lack in the collection, may provide means to supply the deficiency.

Aside from the fur-bearing species the majority of seals, both as to number and species, are found in northern waters and, as these lie near at hand or are easily reached, it is not surprising that seals from the Northern Hemisphere form the bulk of the collection. Our northernmost representative is the ringed seal, small in size but once of prime importance to the Eskimo as an article of food—in fact, in days gone by it might almost have been termed the Eskimo's "staff of life." Stefánsson, too, relied largely on this seal for *his* food supply. The ice may force the bulky walrus south to dig his clams, but the little ringed seal bores through the ice floes for air, while beneath them he manages to gain a scanty livelihood. Associated



The ringed seal (*Phoca fœtida*) has been the "staff of life" of the Eskimo during many a winter of the past

with him, but far less common and much more difficult to capture, is the big bearded seal, or square flipper, which reaches a weight of five hundred pounds. Neither of these seals is found in sufficient numbers to be important

FUR SEALS AT KITOVI ROOKERY, ST. PAUL ISLAND, BEHRING SEA

These specimens of *Callorhinus alascanus*, mounted by Frederick Blaschke, are the center of interest in the large Fur Seal Group prepared for the Hall of Ocean Life. Only a part of the group is here shown

commercially, which is doubtless fortunate for the Eskimo as well as the seal.

Found with the ringed seal in the southern part of its range is the Greenland, or harp seal, commercially the most important of the true, or earless, seals. This is the species that at breeding time assembles in thousands on the ice floes and drifts southward to be slaughtered by the hardy Newfoundland fishermen. And while the killing of the seals is mere butchery, yet such are the attendant conditions of wind and weather that it is a most hazardous occupation and many a ship and many a man have been lost in its prosecution. This hazard is to the advantage of the seal herd, a bad season for the sealers meaning a good season for the seals, and it is the writer's belief that but for these "bad seasons," the seals could not for so long have withstood the yearly drain upon their numbers—even though there are wise laws restricting the length of the killing season and forbidding vessels to leave St. Johns, the headquarters of the sealing fleet, before a given date. What this drain is may be gathered from Levi G. Chafe's *Report of the Newfoundland Seal Fishery*, from which it appears that on an average about 125,000 seals are taken yearly, the smallest catch on record being just under 34,000 and the largest over 350,000.

The harp seals taken fall into various categories—white coats (those under two weeks old), gray coats (from three weeks to a year), bedlamers (from one to three years), and old harps (the adults). The newly born seals are clad in a white coat of thick woolly fur—hence their name. At the end of about two weeks this peels off—as does the down from many sea birds—leaving the young clad for a year in a suit of shiny steel gray. Those from one to three years old wear a more or less mottled coat of short hair, like that of the ordinary hair seal, the conspicuous black saddle of the adult not being assumed for several years. But why call the young seals bedlamers? Judge Prowse suggested that it was because, when attacked, they were so frightened that they acted like Bedlamites—a plausible suggestion but, like many a similar explanation, not the right one. The correct etymology was furnished by some one better versed in the queer twists that have befallen many Newfoundland names—such, for example, as that which transformed the Bay of Hope, Bai d'Espoir, into Bay Despair—and we learn that "bedlamer" is only a corruption of the French *bête de la mer*, really very simple. Scattered among the harps—though less numerous—are the big hoods, so called because the males have the power of blowing up a sack on the end of the nose. These form but a small portion of the catch.

What becomes of all these seals? The majority of them are converted into leather, and the finer grades of our sealskin belts and pocketbooks come from the hides of the young. A few are transformed into wolf- and bearskin furs, but the fur is too woolly to make a really good imitation. The fat, or blubber, is reduced to a very clear, tasteless oil—some of which, it is whispered, passes as cod liver oil.

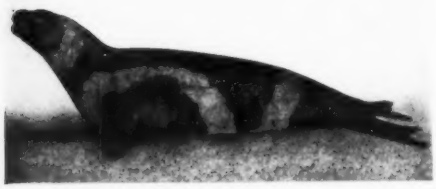
The big gray, or horsehead seal, though shy and scarce, is present in the American Museum collection but there is little to be said about him. Rarest of northern seals, though also included in the collection, is the strangely marked ribbon seal, a straggler from the Siberian coast. His boldly marked coat is, or was, in de-

FUR SEALS AT KITOVI ROOKERY, ST. PAUL ISLAND, BEHRING SEA

These specimens of *Callorhinus alascanus*, mounted by Frederick Blaschke, are the center of interest in the large Fur Seal Group prepared for the Hall of Ocean Life. Only a part of the group is here shown

mand to supply the well dressed Eskimo with holiday apparel.

Finally, among our northern seals we have the harbor seal, the one most familiar to residents and summer visitors on our Atlantic coast. Once



A male ribbon seal (*Phoca fasciata*).—The female is somewhat larger and her markings are much fainter

it was common in New York Harbor, where its name still survives in Robbins Reef, a corruption of the Dutch *robben* (seals) denoting a place where seals "haul out" to bask in the sun, and even in recent years an occasional seal has found its way into the Hudson. Formerly plentiful along our eastern coast, the seal has become comparatively rare, owing to the fact that seals and fishermen do not agree on the fish question. The fishermen consider that they have the exclusive right to take fish and, after they have depleted the shore fisheries by their wasteful and destructive methods, discover that it is really the seal which is to blame and forthwith put a price upon his head, or rather upon his tail, that being the end that must be presented by claimants for bounty. For several seasons some Penobscot Indians did a flourishing business right in Boston Harbor but, since the seal became an outlaw, he has been rare not only there but elsewhere. Not that seals do not eat fish—for they do—but the damage they inflict is slight compared with that done by the fishermen, and they do not waste the fish and it is a fairly easy matter to keep the seals within bounds.

The Caribbean seal is noteworthy for various reasons: first, because he and his immediate relatives are exceptional among hair seals in that they dwell in tropical waters instead of icy seas, and secondly because he has the distinction of being the first animal to be described from the New World, having been noted on the second voyage of Columbus in 1494. Of course Columbus must have seen other new animals but apparently they were not described.

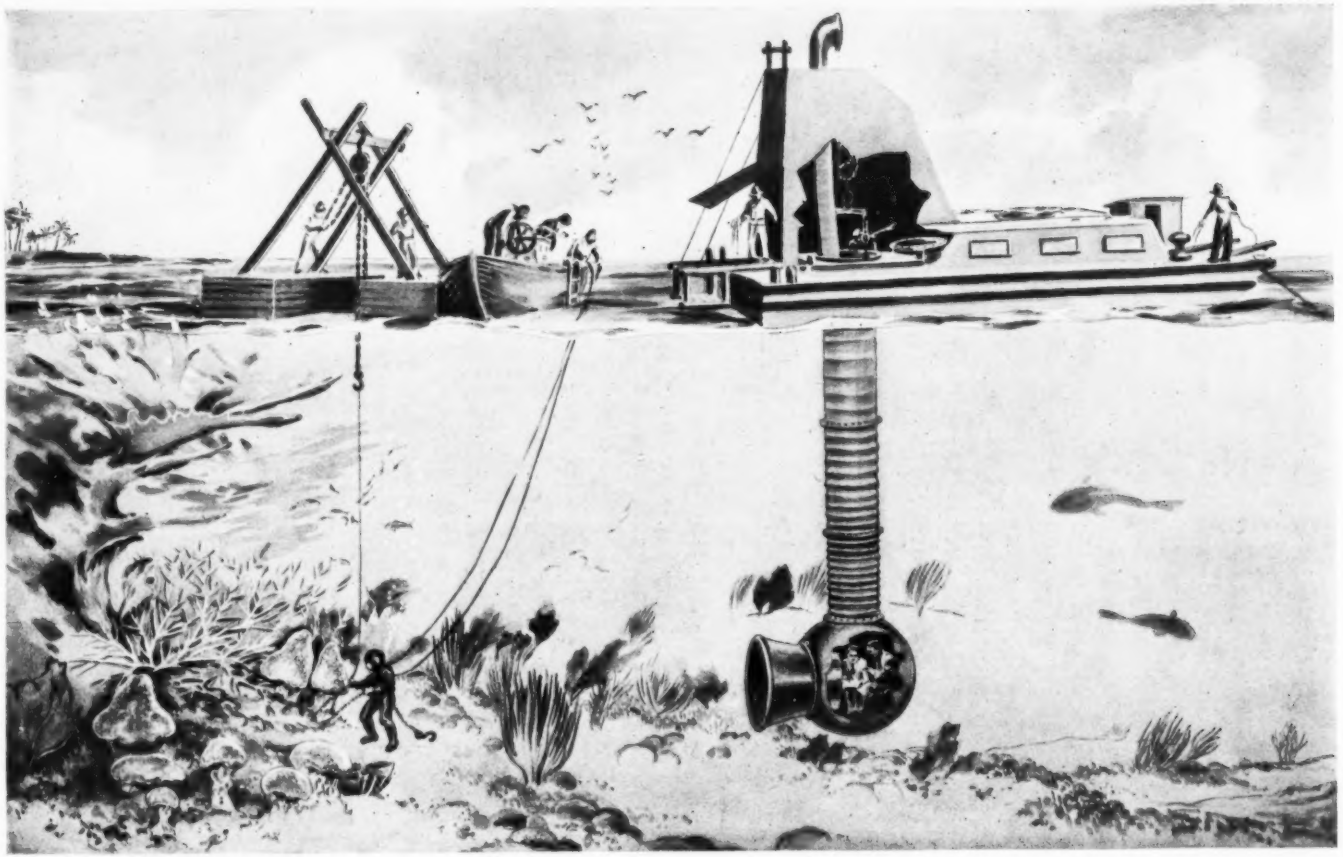
A male Caribbean seal (*Monachus tropicalis*) obtained at the Triangles by Henry L. Ward in 1886.—The blotches are not the result of any skin disease but are patches of old hair that has not yet been shed

As for the seal, it is recorded in the log book that on the islet of Alta Vela, off the coast of Haiti, the sailors came upon a band of "sea wolves," eight of which they killed: thus was the Caribbean seal made aware, in the usual manner, of the coming of the white man.

Still another point of interest lies in the fact that while one relative of the Caribbean seal is found in the Mediterranean—provided he has not been recently exterminated—another is found on Laysan Island in the Mid-Pacific. How did his ancestors get so far from home? Did they come through the strait that for a time connected the Gulf of Mexico with the Pacific? If so, why did none of them tarry by the wayside and populate the Hawaiian Islands? Once abundant not only on many of the West Indian Islands but also on the Bahamas, the Caribbean seal, unused to man and easily killed, was soon reduced in numbers, thanks to the demand for oil and hides, and for many years past has led a precarious existence at one or two places in the Gulf of Mexico, especially at some rocky islets known as the Triangles. Even here it is in danger and recently the Mexican government has called upon our own for aid in preventing its extermination.

So much for the northern seals; those of the Southern Hemisphere, aside from skulls and skeletons, are but scantily represented in the Museum collections, a single example of Weddell's seal being the sole representative of those found on the ice that fringes the shores of the Antarctic Continent. The Museum needs examples of the big, active sea leopard—one of the largest of the earless seals, quick enough to escape the killer whale and quick enough to catch and devour the amphibious penguin. Especially does the Museum need specimens of the various southern fur seals that were so ruthlessly and wastefully killed by the hardy sealers of New London, who made their way into the Antarctic long before it was charted. The killing is termed wasteful because no attempt was made to preserve the race—males, females, and young being killed indiscriminately—and because thousands of skins were lost through improper treatment. This is doubly unfortunate because the southern seals do not seem to have the recuperative power of their northern relatives, and their former breeding grounds still remain the barren wastes they were left by the sealers nearly a century ago, the only protected colony being found on an island in the La Plata River belonging to the Argentine Republic, which yields several thousand skins yearly. The only eared seal of the south that the Museum has is the southern sea lion, obtained by the Harrison Williams Expedition to the Galápagos.

So here we stop for want of material, hoping in time to add another chapter to the story of our seals.



COLLECTING CORALS ON THE ANDROS REEF

The diver fastens a chain sling about the base of a desired specimen while the crew of the pontoon prepare to raise it with a chain hoist. Meanwhile members of the Museum staff photograph and sketch the living corals through the window of the tube's submarine chamber, and direct the diver's operations by means of signals. Drawn by Malcolm Jamieson after sketches by J. E. Williamson and members of the Museum staff

Hunting Corals in the Bahamas

By ROY WALDO MINER
Curator of Lower Invertebrates, American Museum

Note.—The expedition, the achievements of which are recorded in this article, was made possible through the Angelo Heilprin Exploration Fund and through the general funds of the American Museum. The success of the expedition was assured through the generous coöperation of The Submarine Film Corporation and its parent company, the Williamson Submarine Tube Corporation, as well as through A. Schrader's Sons, Inc., which donated a complete diving outfit.

HUNTING corals with a submarine tube, diving apparatus, and pontoons fitted with chain hoists is doubtless a unique experience, though many collections have been made in the past by means of more primitive apparatus and native divers. The writer has just had the privilege of leading an expedition of the former kind to Andros Island in the Bahamas, where, through the efficient coöperation of Mr. J. E. Williamson, manager of The Submarine Film Corporation, a large collection of corals was obtained, together with photographs, sketches, motion pictures, and other data, to be utilized in constructing a reproduction of a typical Bahaman coral reef as an exhibit in the American Museum's new Hall of Ocean Life.

The expedition, which included in addition to Mr. Williamson and the writer the following Museum artists, Mr. Herman Mueller, glass modeler, Mr. Chris. E. Olsen, modeler and artist, and Dr. George H. Childs, colorist, left New York on June 6, reaching Nassau in the Bahamas three days later. After eight days in this beautiful and historic West Indian port, spent in arranging for the coöperation of the Bahaman government and in outfitting and organizing for the trip, the party left for Mangrove Cay, Andros, on the evening of June 17, with a fleet consisting of a forty-five-foot gasoline yacht, the "Standard," two motor boats, the Williamson submarine tube apparatus, a pontoon with chain hoist, and two dinghys. This fleet was towed by the "Lady Cordeaux," a sea-going tug of considerable size, owned by the Bahaman government, which courteously lent it to conduct our fleet across the dangerous arm of the sea known as the Tongue of the Ocean.

There was a full moon and a calm sea, so the trip was made without incident and we arrived off the reefs at Mangrove Cay about daybreak, June 18.

Andros "Island" is really an archipelago, for it is intersected by three bights, extending completely through the land mass from east to west, and by many subsidiary channels, that cut it up into a multitude of cays of various sizes, and form a veritable labyrinth of waterways. They are so narrow, however, as to give Andros superficially the appearance of a single body of land, extending in a general north and south direction for about one hundred twenty miles, and forming the largest land area in the Bahamas.

The "island" is for the most part low-lying, with no elevations greater than one hundred feet, and is composed mostly of coral limestone of relatively recent formation. There is much low and scrubby vegetation with occasional forests of large trees of exceedingly hard wood, called by the natives "horseflesh" because of its red color. In the interior there are extensive mangrove swamps, some of them still occupied by large colonies of flamin-

Meanwhile members of the Museum staff photograph and sketch the living corals through the window of the tube's submarine chamber, and direct the diver's operations by means of signals. Drawn by Malcolm Jamieson after sketches by J. E. Williamson and members of the Museum staff

goes, which are now protected by the Bahaman government. The western shore shelves off gradually to form the Great Bahama Bank, composed of shallow coral and sand flats,—one of the most important sponge-fishing grounds in the West Indies. The eastern shore, on the other hand, rises abruptly from the Tongue of the Ocean, —a depth of a thousand fathoms. At a distance of about one to two miles from the eastern shore is the most typical barrier reef in the West Indies, extending the entire length of Andros. This remarkable coral reef was the immediate objective of the expedition. We pitched our work tents on Little Golding Cay near a beautiful sandy beach on the sheltered side of the island, while the fleet anchored in the lagoon near by.

Little Golding Cay is an islet situated out on the reef itself near one of the entrances to the lagoon. The outer side is exposed to the trade winds, which blow almost continuously from the southeast, dashing the waves against the coral rock which forms its shore and eroding it into fantastic pinnacles. The greater part of the cay is covered with low vegetation,—mostly fragrant bastard logwood, gumbo limbo trees writhing in fantastic shapes, rose apples with their scarlet blossoms, seven-year apples, and sea grape along the shore, bordered by bay lavender and other low shrubs. Terns nest in the hollows of the rocks, and herons, called by the natives "poor Joes," perch in the trees. So tame are they that one may approach them closely. On the lagoon side of the island is the crescent-shaped beach mentioned above, composed of white coral sand, and forming an admirable landing place for the coral specimens.

A description of the submarine tube will aid in understanding our methods of work. This remarkable apparatus was invented by Mr. Williamson's father and was adapted by the son for submarine photography. It consists of a barge, the "Jules Verne," surmounted by a tower containing chain hoists. Beneath the tower is the well, through which is lowered a tube composed of flexible sections securely bolted together. These are about two feet in diameter and readily admit the body of a man. The lower end of the bottom section opens into a spherical chamber five feet in diameter, in which two or three persons can be comfortably seated. From it they gaze out through a plate glass window an inch and a half thick into the world at the bottom of the sea. A ventilator at the top of the tube draws fresh air into the chamber by means of a canvas chute, so that one breathes easily and comfortably many feet below the surface of the water. Sections added at the top permit the lowering of the chamber to any desired depth. This tube was a most important factor in the success of the expedition as used in conjunction with the subsidiary apparatus and the Schrader diving equipment.

I shall never forget my first view of the barrier reef as seen through the window of the tube. Great trees of the reef-forming coral (*Acropora palmata*) rose from the reef platform constituting a veritable stone forest with closely interlacing branches, a marble jungle which melted into the pearly blue haze of the watery atmosphere, the wide branches often breaking the surface of the water at low tide, especially on the side toward the lagoon. Multitudinous schools of reef fishes were swimming in and out through the

forest aisles in stately procession, each species keeping much to itself in exclusive fashion. Jacks, yellowtails, black angels, blue angels, blue parrot fishes, groupers, red snappers, and countless smaller brilliantly colored species were visible in great numbers. Once an enormous jewfish came slowly into view around a coral tree trunk, its huge mouth gaping as it swam slowly toward the tube and gazed at us with bleary eyes. As the tube was moved slowly back and forth by the men above, an ever-changing panorama revealed itself to our view. At times the forest opened to disclose submarine glades dotted with coral growths of fantastic shape. Posts of coral rock topped by dome-shaped heads of *Orbicella* reminded one of huge mushrooms, while beautiful fronds of the fan coral (*Acropora prolifera*) crowned mounds adorned by sulphur yellow *Porites* and waving sea fans of magenta and gold. The great staghorn coral (*Acropora cervicornis*) covered extensive areas of the reef platform, especially in front of the coral groves, its sharp, branching spikes forming intertangled masses menacing in every direction, like a complicated and confused *chevaux de frise*. Immense domes of the star coral (*Siderastræa*) and the brain coral (*Meandra*) showed here and there, diversified by brown, white-tipped fronds of stinging coral growths (*Millepora alcicornis*).

Suddenly into the midst of the strange beauty of the submarine jungle Williamson came floating down equipped with diving helmet. Now he advanced like some strange monster with slow half-gliding strides, grotesquely peering at us through the goggle-eye windows of the helmet. A long crowbar had been lowered to him and, placing it like a lance in rest, he assailed a large branching coral. The bar was not needed, for the coral fell at a touch from the point and, fastened to a lowered rope, was quickly hauled to the surface. A bucket was now let down and filled with smaller pieces while we signaled directions from the window of the submarine chamber.

On other occasions the pontoon was towed out and the chain hoist lowered. The diving equipment would be utilized to fasten a chain sling around the base of a heavy coral. The chain would be pulled taut from above and we would wait for the next wave to lift the pontoon and jerk the coral loose. The coral would then be hauled to the surface and towed ashore on the pontoon. Our largest specimens were secured in this way. The record specimen measures twelve feet and, it is estimated, weighs about two tons.

Raising a coral specimen to the deck of the pontoon by means of steel tongs and a ten-ton chain hoist. Though very heavy specimens were successfully lifted in this way, the tough steel of the tongs was finally bent in an endeavor to secure an unusually large example

Bleaching and packing corals on the shore of Little Golding Cay.—In the right foreground a box is being built around the twelve-foot specimen. In the distance may be seen, from left to right, the Williamson Submarine Tube, the yacht, the pontoon, and other vessels of the Museum fleet

As soon as the corals were collected, they were towed to the sandy beach on Little Golding Cay and stranded at high tide. Here they were put through the bleaching process by Mr. Herman Mueller, the glass modeler of the Museum staff, who is also an expert in the preparation of coral specimens. As the bleaching proceeded, the specimens were gradually moved up the beach, until finally they rested, snowy white, above the high-tide limit. One of the coral heads, a *Siderastræa*, was so heavy that it required twelve men to roll it up the beach, which soon assumed the appearance of a coral reef as it bristled with our accumulated specimens. Long festoons of drying sea fans and sea plumes, stretched between the tents, added a gay touch of color to the scene.

Then came the problem of packing, which was no small undertaking in this out-of-the-way corner of the world. We were sixty-five miles from Nassau, the nearest port from which supplies could be obtained, and our forest of corals looked formidable. But we arranged with native sloops to bring us lumber from Nassau. Sponge clippings from a sponge establishment at Mangrove Cay five miles away furnished us with an admirable packing material, showing that even in the outer islands natural resources of the environment will occasionally quite unexpectedly solve the problems that arise.[1] Sponge clippings are the waste pieces of sponge resulting from the process of trimming which commercial sponges go through in being prepared for the market. First the corals were swaddled in burlap. Then cases were built from rough lumber to fit the specimens, which were anchored securely in position and packed tightly in the sponge clippings, smaller corals being fitted in the spaces about the larger ones as the work proceeded. Thirty-one cases of corals were prepared in this way, requiring three thousand feet of lumber and ten boatloads of sponge clippings. The total

[1]Reference may be made in this connection to the way in which the Third Asiatic Expedition solved its packing problem in Mongolia, by using the camel's wool gathered from the animals of the caravan to protect the fragile fossils.

weight was estimated at more than forty tons.

The submarine tube was also utilized for the important work of photographing the coral reefs from beneath the sea. More than a thousand photographs were taken during the trip, including under-sea pictures as well as miscellaneous photographs of the surrounding region and those illustrating the methods employed. About two thousand feet of motion pictures were also secured. The tube was employed for the first time on record for making water-color sketches of living corals and associated forms beneath the sea. Mr. Chris E. Olsen and Dr. George H. Childs, artists on the Museum staff, were charged with this work and painted more than sixty water-color sketches, which will be invaluable in constructing the proposed group.

Photographing and sketching in the tube could be carried on only in calm weather outside the reef. Unfortunately we were considerably hindered in this part of the work by the almost continuous trade winds, which prevented us from anchoring the barge outside. On one occasion, however, we made the attempt and worked while the tube was swinging like a pendulum among the coral heads with the motion of the waves as they dashed against the reef. This was too risky to repeat as there was constant danger that the glass window would be forced against some projecting coral and broken. Luckily some calm days were given us when the

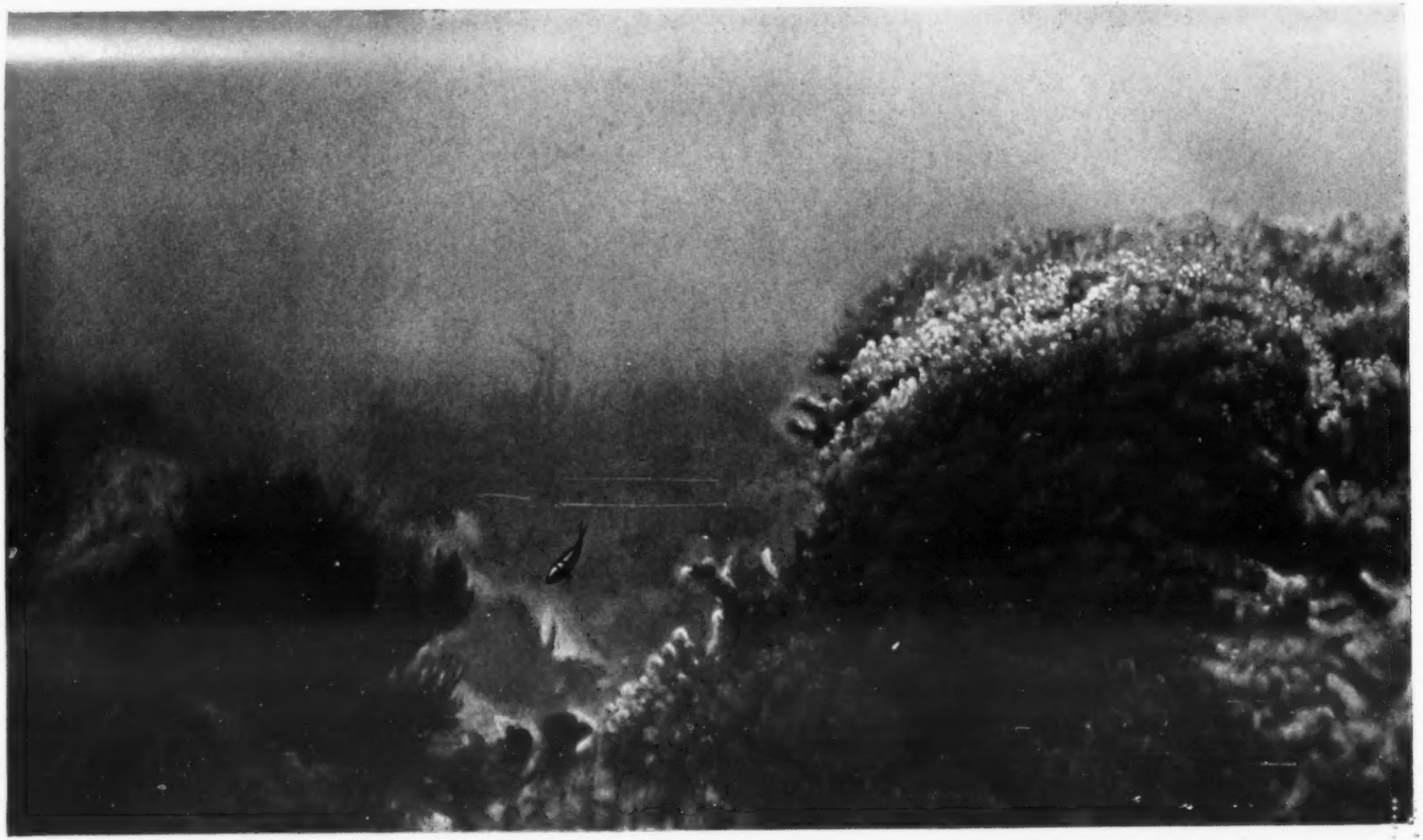
The Williamson Submarine Tube, viewed from the "Lady Cordeaux."—Boxes of corals cover the deck of the barge. The low-lying shore of Andros Island shows in the distance

wind blew off shore, and in one instance we were able to work for hours at a stretch in the tube, photographing almost continuously under perfect conditions. Not a little work was done among the coral clusters in the more quiet waters of Hog Cay Channel, at the northern side of Middle Bight Entrance.

As may be inferred from the number of fish seen about the coral reef, fishing in the lagoon brought quick returns. Our table was always plentifully supplied. On one occasion I told a little native boy who was helping us, to get us some fish for next morning's breakfast. He asked me what kind I wanted. I said, "Red snappers." Within an hour he brought me thirty-four of these fish! At times we feasted on green turtle. Sharks were abundant and we had an adventure with one of them. Some of our men were sent ashore in the small motor boat to obtain a supply of water. A shark apparently mistook the fishlike bottom of the boat for legitimate prey and darted for the moving propeller. He was thrown completely out of the water, revealing a deep gash under the jaw. He turned over two or three times as he fell back, and then disappeared. The motor stopped completely as the men felt the shock of the impact, and it was found afterward that the propeller shaft was sprung and that the stuffing box leaked. The boat was put out of commission as a motor boat for the remainder of our stay.

We found the Andros natives of considerable help to us. Three of them came to us every morning a distance of five miles in a little sailboat hardly large enough to contain them, and looked much like the three wise men of Gotham as they strove to keep their balance in their tiny craft. At one time there were nineteen men in our party busily engaged in preparing the collections for shipment. Finally, the morning of July 15, the "Lady Cordeaux" arrived to take us back to Nassau and found us all prepared. We lightered our sixty-two cases of corals and equipment out to her at the reef entrance, by means of the barge and the pontoon, and the next morning we were all safe in Nassau Harbor.

During our stay at Andros we received much assistance and many courtesies from Commissioner Elgin W. Forsyth, whose knowledge and experience of the reefs were invaluable to us, as well as his services in securing native helpers and fresh provisions. The Bahaman government, through Administrator Burns and other officials, gave us every facility, and the people of Nassau generally took much interest in our enterprise. The capable work of Captain Lewis Isaacs of the "Jules Verne" and Captain Joseph Bethell of the "Standard" was most important to our success in acquiring the collection. The final ten days of our trip were spent first in visiting the remarkable coral formations known as "boilers" at Harbor Island, and secondly in organizing our collections and equipment for the homeward trip on the "Munargo" on July 27. Three days later we arrived in New York.



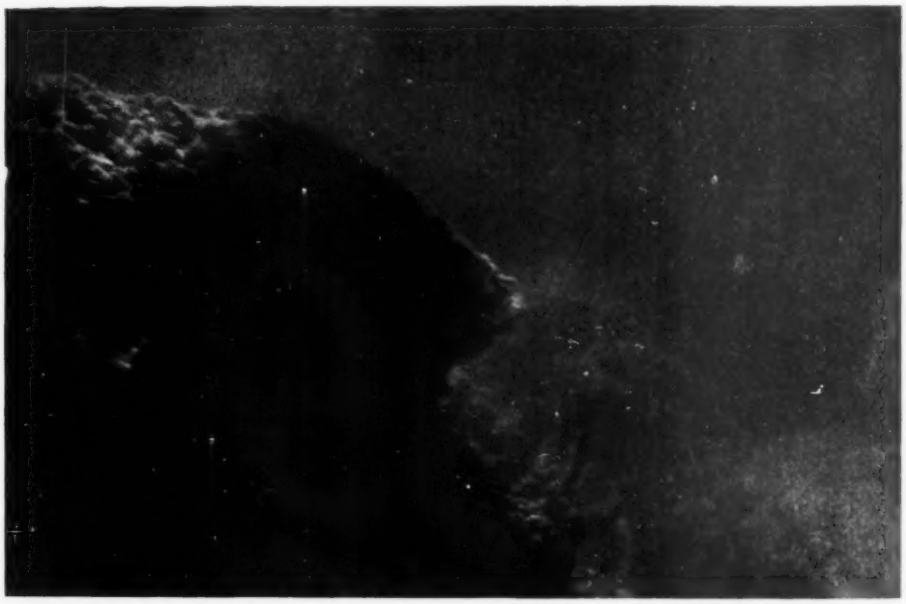
A CORAL FAIRY LAND IN THE ANDROS LAGOON

A brilliantly colored reef fish (*Thalassoma bifasciatum*) swims into a beam of sunlight between purple and brown sea bushes (*Gorgonia*) and a towering bank of *Porites* coral. From a photograph by Roy Waldo Miner, colored, under the supervision of Doctor Miner, by William E. Belanske

The Coral Gardens of Andros

PHOTOGRAPHED THROUGH THE WILLIAMSON SUBMARINE TUBE

By ROY WALDO MINER AND J. E. WILLIAMSON

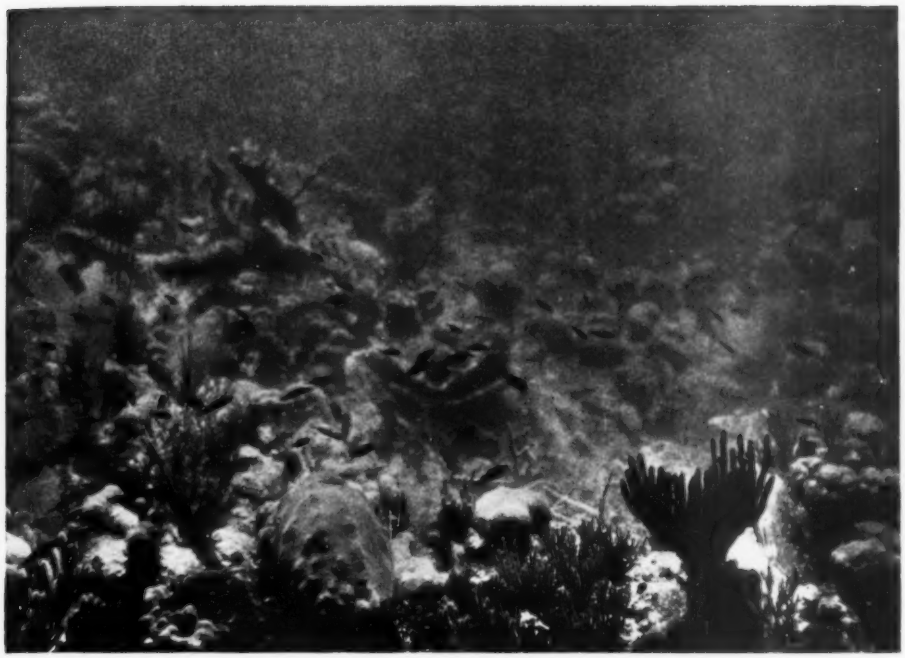


A bank of branched *Porites* corals.—Thousands of close-set individual specimens make up these formations

Mr. Williamson, of The Submarine Film Corporation, collecting corals in a Schrader diving suit.—He is looping a rope about a fine specimen of fan coral (*Acropora prolifera*) so that it may be hauled to the surface of the sea

Coral posts crowned with dome-shaped living colonies of *Orbicella* rise beside the more foliate expansions of the stinging coral, *Millepora*

Glimpse through the branches of a submerged coral forest, composed of the palmate coral, *Acropora palmata*



Sunlit aisles of the sea-forest floor with reef fishes swimming about the fronds of the treelike gorgonians, or sea bushes

Waving masses of many-fingered gorgonians grow luxuriantly among the corals, adding color and grace to the scene

AN ANDROS SEA GARDEN ALIGHT WITH SUNSHINE

In the foreground is a luxuriant growth of richly tinted gorgonians. In the background to the right the beautiful palmate coral, *Acropora palmata*, spreads broad branches

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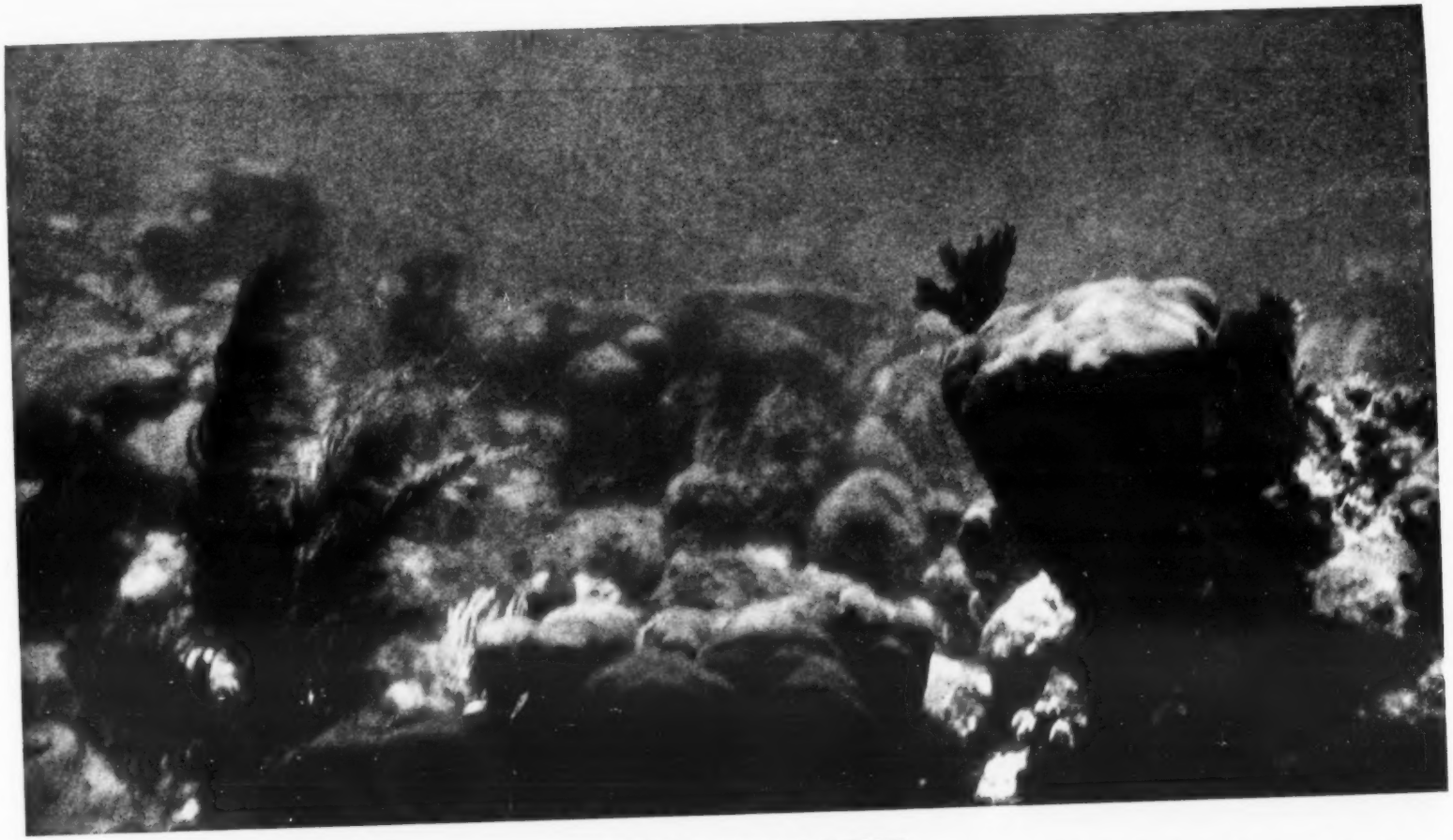
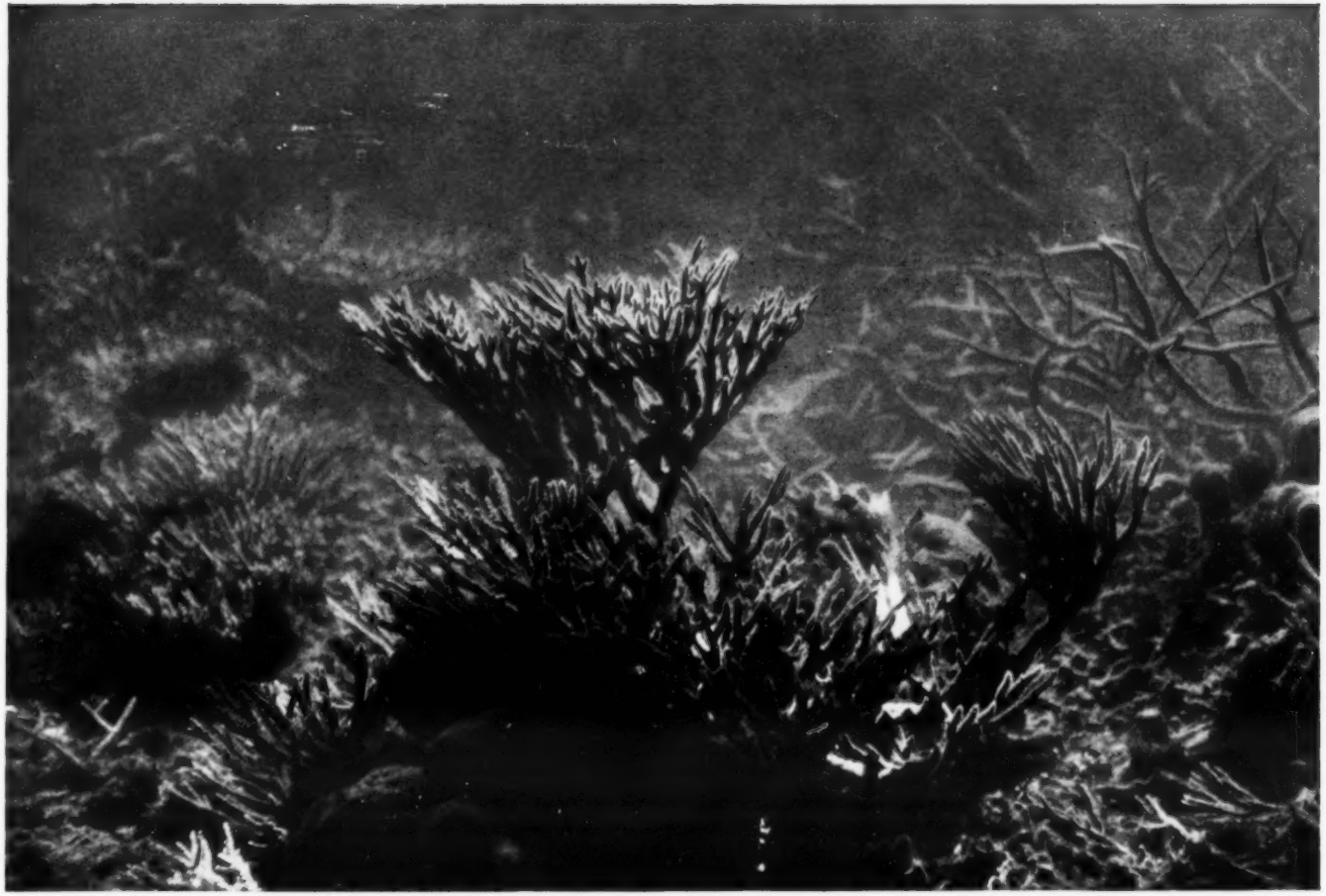


SEA PLUMES AND CORAL POSTS

A vista through a submarine fairyland of magenta and gold. Such views appear in every direction through the clearings of the ocean forests



STAGHORNS AND FAN CORALS

Here and there beautiful clusters of fan coral (*Acropora prolifera*) of wondrous symmetry and almost unbelievable delicacy border beds bristling with interlacing masses of staghorns (*Acropora cervicornis*), shown in the right of the picture

Here and there beautiful clusters of fan coral (*Acropora prolifera*) of wondrous symmetry and almost unbelievable delicacy border beds bristling with interlacing masses of staghorns (*Acropora cervicornis*), shown in the right of the picture

A TYPICAL PALMATE CORAL GROWTH

These palmate corals rise, with broad handlike branches, sometimes fifteen or twenty feet in height, their uppermost tips breaking the surface of the water at low tide. They form the most characteristic growth of the West Indian barrier reef

A VISTA ALONG THE EDGE OF A CORAL BANK

Club-fingered *Gorgonia* and tube sponges (*Spinosella*) melt into the opalescent, watery haze. Brilliantly colored reef fishes, gleaming like jewels, dart in and out among the submarine growths

A Submarine Cable Among the Corals

By CHARLES HASKINS TOWNSEND
Director of the New York Aquarium

WHEN the "Albatross" reached Tahiti in 1899 during the Tropical Pacific Expedition in charge of Alexander Agassiz, Mr. Agassiz's first move was, in his own words, "to determine, if possible, the rate of growth of the corals on Dolphin Bank from the marks which had been placed on Point Venus by Wilkes in 1839."

We had finished a month's work among the atolls of the Low Archipelago, during which corals and the formation of coral islands had been the principal subjects of conversation.

The stones and marks set up by Wilkes at Tahiti were readily located but proved a disappointment. There were only a few scattered heads of coral growing on Dolphin Bank. Its choice as a standard by which to measure coral growth was unfortunate. As Mr. Agassiz reported the findings: "An excellent opportunity had been lost to determine the growth of corals during a period of sixty years."

Among those who attacked the problem of the growth rate of corals by setting up marks, was the late Dr. A. G. Mayor, who accompanied Mr. Agassiz on the "Albatross." Dr. T. W. Vaughan's experiments with several species of shallow-water corals at Mayor's laboratory at Tortugas and also in the Bahamas soon showed annual growths of as much as 95 mm. in diameter. Doctor Mayor's studies on the reefs at Samoa served to confirm those of observers in other parts of the Pacific, that Pacific corals grow at about twice the rate of corresponding genera in the Atlantic.

The preceding remarks are made merely by way of introducing some comments on the photograph, illustrative of coral growth, which appears on the following page. When passing the office of the Commercial Cable Company at Fifth Avenue and 46th Street, New York City, I noticed in the window a section of cable bearing a mass of coral with the following label:

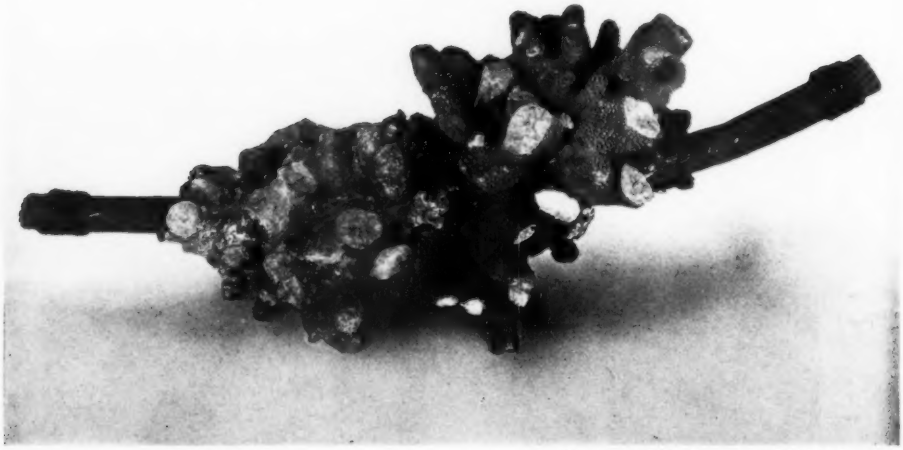
> Section of cable overgrown with coral, picked up by the Cableship "Restorer" in the Pacific Ocean, Feb. 8, 1923. The Commercial Pacific Cable extending from San Francisco to the Philippines was completed July 4, 1903. This section was part of the original cable, and was picked up in shallow water just off Honolulu in the course of a repair. Thus the coral grew around the cable in the course of twenty years.

With the kind permission of Manager Thornburg the specimen—a species of *Pocillopora*—was photographed. The mass of coral measures 24 inches in length by 16 inches in greatest width, the diameter of the cable being 2½ inches.

There is no information at present available as to the depth at which the cable lay on the reef, nor do we know when coral growth upon it commenced, for the cable was not examined for twenty years. According to Mr. Thornburg there is a marked irregularity in the growth of coral; at times it appears to proceed very fast and at other times and in other places there is no growth at all. He also states that coral growth on cables placed in shallow water around the Hawaiian group has occasioned trouble but that cables located in deep water have not been affected.

The Commercial Cable Company

A VISTA ALONG THE EDGE OF A CORAL BANK
Club-fingered *Gorgonia* and tube sponges (*Spinosella*) melt into the opalescent, watery haze. Brilliantly colored reef fishes, gleaming like jewels, dart in and out among the submarine growths



Courtesy of the Commercial Cable Company

A section of cable laid in 1903.—The age of its growth of coral (*Pocillopora*) falls, therefore, within the two decades that have since elapsed and, according to an eminent authority, may be less than ten years. The coral mass measures 24 inches in length by 16 inches in greatest width,—an indication of the rapidity of growth

has no other specimen of this kind and no photographs of corals attached to cables, but such growths are often found when submarine cables are lifted. The Halifax-Bermuda Cable, which lay on the Bermuda reef for twenty years at a depth of twenty feet, was raised in 1923. It came up heavily loaded with both stony and gorgonian corals, some of the latter being the common "sea fans" that are often sold to tourists. Doctor Vaughan tells me there is nothing very conclusive in the finding of coral growths on cables which have been long under water, as the date of fixation of the larvæ is unknown, and suggests that the growth pictured here might be less than ten years old. It is probable that the galvanized outer strands of the cable would not offer an attractive surface for the attachment of coral larvæ until they had "weathered" for a time in sea water.

It would seem that sections of old submarine cable, long enough to be easily recovered, would be ideal material for the gathering of evidence as to the time required for coral growth if placed in favorable locations and examined at suitable intervals.

"Pearls and Savages"

A REVIEW OF CAPTAIN FRANK HURLEY'S VOLUME ON NEW GUINEA[1]

By WILLIAM K. GREGORY

Curator of Comparative and Human Anatomy, American Museum

THE great island of New Guinea, one of the least-known quarters of the globe, forms a link between Australia on the south and the Malaysian region to the northwest and west, and is therefore of the greatest interest to the geologist, anthropologist, zoölogist, and botanist. Not very far back in geological time it was undoubtedly connected with Australia—as we may infer not only from the relative shallowness of the waters that now separate these land masses, but also from the presence in New Guinea of a number of animals and plants the nearest relatives of which live in Queensland. Perhaps about the time that the Glacial Period was coming on in Europe there were terrific disturbances in the region of New Guinea. The very foundations of the earth gave way, great blocks of rock strata were faulted downward and others were pushed upward, giving rise to the precipitous rock cliffs, many thousands of feet in height, which in some places in the existing mountains of the interior still attest the magnitude of these displacements. At the same time the land toward the south subsided beneath the sea level, the waters of the Indian and Pacific oceans rushed in from either side and, cutting off New Guinea from Australia, formed the Coral Sea and Torres Straits.

It was in these now fairly tranquil tropical waters that Captain Frank Hurley descended into the sea with the pearl divers and secured many beautiful photographs illustrating the swarming life of the coral reefs; but the greater part of his *Pearls and Savages* is devoted to his experiences with the natives of the southeastern prong of the island and of the Lake Murray region.

In the course of Shackelton's South Polar expedition Hurley had been one of a shipwrecked party that had finally won its way back to the base camp after the most intense struggles and sufferings. In these bitter Antarctic temperatures some of the men had dreamed of the steaming tropical jungles, and thus was born Hurley's determination to explore New Guinea. After his arduous and brilliant record as a photographer in the Antarctic and in the Great War, Hurley might well have been excused if he had picked an easier objective for his next bit of exploring than the interior of New Guinea, but it is fortunate for the world that he made the choice that he did and lived to bring back the superb photographs which now adorn his book.

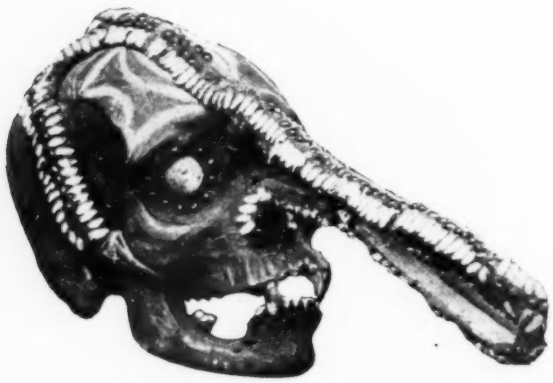
Starting from Sydney, Australia, Hurley first made a preliminary reconnaissance covering a period of ten months, during which he cruised in the Coral Sea and visited the costal villages of Papua, or southeastern New Guinea. Thus he secured the motion pictures which brought him the means of equipping his second and more extensive expedition. On this expedition he was accompanied by the naturalist Alan McCulloch, of the Australian Museum of Sydney, and the equipment included a flat-bottomed, shallow-draught vessel

[1] *Pearls and Savages* by Captain Frank Hurley. With eighty illustrations and a foreword by G. P. P. Published by G. P. Putnam's Sons.

with an auxiliary engine, and two seaplanes presented by a patron of the expedition and operating in conjunction with the vessel. Radio apparatus on board gave the Australian newspapers a daily account of the expedition, which was followed with tense interest by thousands of people in the great cities of Australia.

The seaplanes eventually had to be sent back because the steaming atmosphere was fast rotting their very fabric, but not before many notable flights had been made and some wonderful moving pictures secured, showing the vast delta of the Kikori River and the native pile dwellings and *ravis*. As for the latter, imagine a structure made of mangrove saplings bent over at the top and thatched with leaves, that stretches like a vast crocodile, in some cases 400 feet long and with a yawning entrance 70 feet in height! Into these dark communal clubhouses Hurley and his intrepid companions ventured and secured in exchange for tin cans, axes, and tobacco, much priceless booty for the anthropologists: artfully prepared human heads, "bullroarers," and other magic-making material. They also witnessed many dazzling ceremonial dances, in which the dark-skinned savages were adorned with the most elaborate feather headdresses, each feather being carefully articulated so as to wave up and down with its owner's movements. The author describes how these people fashion pottery without a potter's wheel, and gives excellent pictures of the ingenious process of making sago out of the pulp of the "sago palm," the latter being the chief source of food, clothing, and shelter for the major portion of the Papuan population.

The author frequently comments upon the "Semitic features" of the people about Lake Murray and of many of the coastal people, but here, as elsewhere, his viewpoint is rather unscientific and the book lacks illuminating comparisons. Nevertheless, the reader who desires to compare the natives that Hurley met with those of other parts of New Guinea, and who is further interested in such larger problems as the relationship of the Papuans with the peoples of New Britain, Australia, and Tasmania, will find in Captain Hurley's book a wealth of instructive detail recorded by his camera.



Bird Banding

By MAUNSELL S. CROSBY

DO the same birds return year after year to the same place? Is the phœbe which is now raising its second brood of the season on top of the column on my piazza the same bird which built there last year, and is her mate the same? Will her children come back next year, nest as near as possible to their birthplace, and perhaps quarrel with their father for possession of the old home? In a few cases, where a bird has shown albinism in its plumage or has possessed an individual song that could be memorized by the observer, it has been recognized in a succeeding year, or at least the probability was strong that if not the same bird, it was one of the descendants of that bird which had inherited the white feathers or peculiarity of song that distinguished the progenitor. We usually assume that the robins, the wrens, and the chippies, which we find so regularly about our homes each year, are our old friends, but how often are we right?

On the other hand, where do these birds spend the winter? We have learned that these delicate creatures annually take immense flights to escape the cold and starvation of our northern winters and that they reach the warmth and plenty of southern climates, and some of us have been surprised during a winter visit to the South to discover such northern acquaintances as the ruby-crowned kinglet and white-throated sparrow perfectly at home in the apparently incongruous surroundings that are afforded by live oaks, cacti, and palmettos. The whitethroat's breeding range extends from northern Mackenzie and Ungava to southern Montana and the mountains of Connecticut, southern New York, and Pennsylvania. Its winter range is from Missouri and Massachusetts to northeastern Mexico and Florida. Do the far-northern breeders winter in New England and are the birds found on the Gulf Coast from the lower ranges of the species, or do the northern breeders make a thorough migration from the top to the bottom of the ranges, while those that nest in the Catskill Mountains of New York simply drift toward the warmer coast until the warmth of spring enables them to drift back?

Do birds always winter in the same place year after year? Do they make what to us seem unusual wanderings or migrations, not in line with the stereotyped flights we have learned to expect of them? How long do free, wild birds normally live—ducks, owls, jays, catbirds, robins? What percentage of birds annually survives natural mortality plus the toll levied by our vast army of sportsmen and gunners? How do we account for so-called accidental visitants? Are they wind-blown wanderers, or inexperienced or lost young birds, or explorers? Whence have they come and how far may their caprice or that of the elements carry them away from their proper course?

No ornithologist can as yet begin to answer most of these questions, but a means has been found whereby some answers have already been suggested, and possibly all may some day be satisfactorily cleared up. This means is bird banding.

Photograph by S. Prentiss Baldwin

The drop trap, or net trap, is propped up by a wooden peg, to which is attached a string, the loose end of which is held by the bird bander. When a bird has been lured beneath the trap by the food there spread out, a tug at the string causes the trap to fall. The gathering box, seen at the left of the photograph, is then applied to the little door in the upper left-hand corner of the trap and the bird is coaxed into this receptacle for banding This trap should be used only by an expert

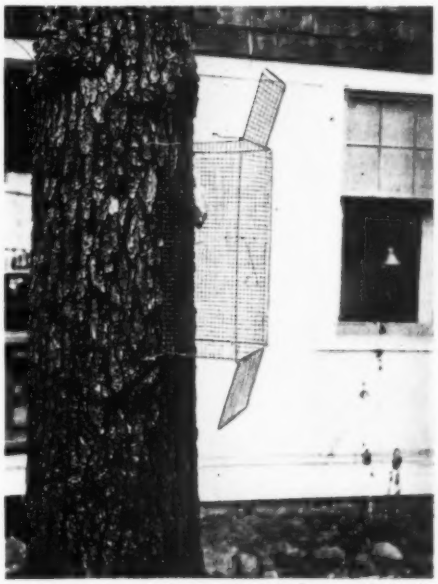
Photograph by S. Prentiss Baldwin

Mr. S. Prentiss Baldwin, widely known for his activities in bird banding, is here seen at Thomasville Station B inducing some captured birds to leave the sparrow trap and enter the gathering cage to the left of it. Sometimes such birds are reluctant to leave the banquet of bread crusts. The trap is placed within a guard fence, erected to keep out cats and dogs

More than two hundred years ago a heron was captured in Germany bearing on its legs several metal rings, one of which, according to the legend on it, had been attached some years earlier in Turkey. A hundred years later a Dutch naturalist named Brugmann marked a number of storks, hoping to find out if they would come back, but his results were negative, for no birds that returned had marks on them. Until 1899 no systematic effort was made to band and then recapture birds, but in that year Herr Mortensen, a Dane, captured birds of several species, banded them, released them, and kept a record of the banding. His success in recapturing banded birds interested a number of ornithologists, so that soon a score of individuals and organizations were drawn into the study. Many practical details had to be worked out: a suitable non-corrosive metal had to be selected for the bands, methods determined upon for numbering, marking, and recording, and also various means of trapping devised. Truly remarkable success along these lines has been obtained, and the published results are most encouraging as well as interesting.[1]

Let us now turn our attention to the United States. Aside from the sporadic experiments of a few investigators, probably the real pioneers were the members of the New Haven Bird Club, which had a number of bands made, and used them somewhat locally during the years immediately preceding 1909, at which time, through the efforts of Dr. Leon J. Cole, the American Bird Banding Association was formed. This organization came under the guidance of the Linnæan Society of New York, but supervision was officially taken over in 1920 by the Bureau of Biological Survey of the United States Department of Agriculture, so as to permit the work to become nation-wide.

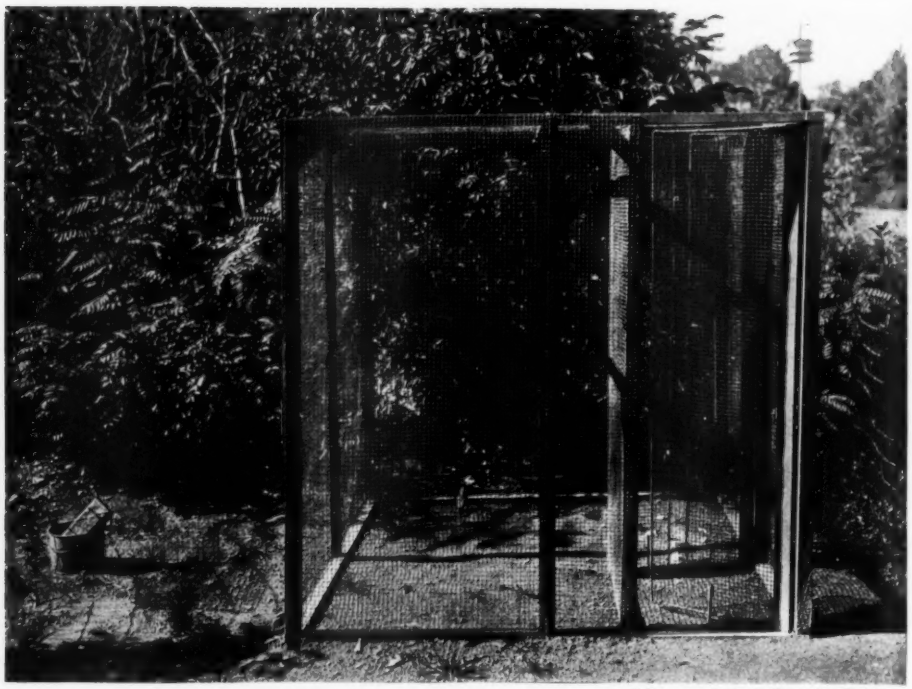
In the meantime, Mr. S. Prentiss Baldwin, of Cleveland, Ohio, one of the most ingenious and indefatigable of bird banders, had made such remarkable return records by using sparrow traps, in which birds could be recaptured again and again without injury, that a new impetus was given to the study, for hitherto most returns had been made through the finding of dead banded birds or the shooting of wild fowl by sportsmen. The old method of recording, which was dependent upon the destruction of the bird, thereby putting an end to its scientific as well as its economic and æsthetic usefulness, has been replaced, through the employment of the trap, by a system based on the return records of living birds, which may subject themselves to capture repeatedly with-



Photograph by S. Prentiss Baldwin

A tree trap, baited with suet and devised for the capture of woodpeckers, nuthatches, and creepers. A pull of an attached string closes the doors at the top and bottom

[1] Lincoln, *Auk*, XXXVIII, 1921, pp. 217–28.



Photograph by S. Prentiss Baldwin

A device of a more elaborate character than those previously shown is the house trap, in which a man can stand erect. There is an outer door at the right and there are two inner doors beyond. All of these are left ajar and the bird is induced to follow the trail of food through the several portals until he loses his way in the interior

out putting their lives in jeopardy. Through the baiting of traps with suitable food and with water for drinking and bathing, a large number of species have already been caught. Chiefly through the interest aroused by Mr. Baldwin, three associations have been formed during the past two years as convenient units, all governed by the Bureau of Biological Survey, which issues bands, permits to trap under the Migratory Bird Treaty, and up-to-date advice on banding, and also keeps the card records of all the banded birds. These smaller societies are the North Eastern, Eastern, and Inland Bird Banding Associations, while on the Pacific Coast the work is being fostered by the Cooper Ornithological Club. They are able by their character to stimulate interest, increase the number of banders, attack local problems, and perform other useful services. Already many hundreds of members have joined these associations, a great number have satisfied the government requirements and secured permits to trap, and accurate data on the movement and life of thousands of birds of many species are accumulating in the files of the Bureau of Biological Survey in Washington.

A word about the bands used. They are very light, made of aluminum, and are marked with a serial number and the words "Notify Biol. Surv., Wash., D. C." An amusing transposition of vowels in stamping an early set of bands caused them to be known as the "Boil, Serve, and Wash" series. As now made, they are sufficiently pliable to be opened and closed with the

fingers or a small pair of pliers, and sufficiently rigid to prevent a bird from removing them or from tightening them by hammering with its bill, thereby restricting the circulation or causing other injury to the leg. Properly attached, they slip loosely along the tarsus, are no impediment to the bird, and are not noticeable on a freed bird except at close range.

Slowly, but surely, as return after return is made of birds recaptured after having been previously banded, a wealth of facts is being stored away. Formerly average dates of arrival and departure of migrants over a wide area gave us a general idea of how fast birds traveled. Wells W. Cooke compiled exhaustive and accurate lists contributed by scores of observers, showing dates of arrival and routes taken. But now we have an opportunity to find out how fast the individual travels—how far it actually has flown in one day. I may band a bird today and you may catch it at your station tomorrow many miles north or south. It may rest at your station and go into your trap a number of times, finally to make another long flight on its way, or it may leave you at once, covering a more moderate distance each day. A fox sparrow, one of the first March arrivals, was promptly banded. It returned several times to the trap and did not leave until the very end of April, while in the meantime large flocks of the same species arrived, stayed a day or two, and passed on. The bird was solitary when it arrived, and apparently the influence of the bounty spread before it was greater than that exercised by its relatives swiftly moving by. The more people band birds, especially along well-known highways of migration, such as the Atlantic and Pacific coasts and the Connecticut, Hudson, and Mississippi valleys, the more chance there will be to trace individual histories through the capture of banded specimens and thereby judge the whole movement.

Mr. L. R. Talbot, who operated the Thomasville station in 1922, is seen in the upper picture with a brown thrasher (*Toxostoma rufum*). This bird, No. 19247, was first banded in 1915, was captured with its mate in subsequent years, and was last taken by Mr. Talbot in 1922, being then at least eight years old

An example of this still rare trapping of another person's bird is the case of a purple finch banded at Norwalk, Connecticut, during the winter of 1922–23, and recaptured a few weeks later at Demarest, New Jersey. The purple finch is a particularly erratic bird, being abundant during some winters and nearly absent in others. Possibly food supply may affect its movements, but at all events, during

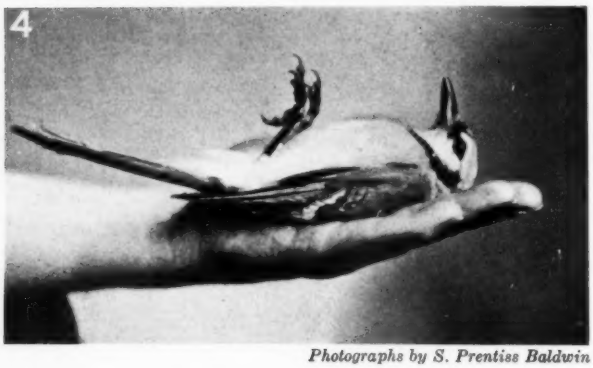
HOW TO HANDLE A BIRD

These four photographs of a captive blue jay (*Cyanocitta cristata*) may serve as a guidance to those who contemplate engaging in bird banding.

In (1) the bird is held for examination with its neck between the first and second fingers, while its feet find a perch on the little finger.

After a bird has been handled for a few moments it becomes impassive and will hang quietly, head downward, without attempting to escape (2).

If a bird is to be banded, (3) is the proper method of approach. For the purpose the little finger is placed over the neck to keep the bird quiet, and the leg is held by the thumb and forefinger until the band is put on.



When the bird is released it may not at once grasp the fact that it is free, lying in the open hand (4) for some time before bestirring itself.

Photographs by S. Prentiss Baldwin

the winter of 1922–23 it was remarkably common throughout southern New England, New York, and New Jersey. In December, 1923, and January, 1924, a banded purple finch was seen in company with an unbanded one at a feeding station four miles south of the writer's traps at Rhinebeck, New York. The presumption is that it was a bird banded by him during the previous winter, as no purple finch had been banded by him subsequently. There were practically no other purple finches about last winter. Why had this one returned and why had it moved to such a distant station? Had it overflown its mark or was the change deliberate? Did its daily foraging area cover both places, or was it originally caught while en route to the second station?

It has been definitely established by trapping that a certain percentage of birds do return, not only to their nesting sites in spring, but also to their winter quarters in autumn. Mr. Baldwin's Cleveland house wrens (the genealogies of which he is recording and the actions and relations of which are most interesting and amusing) are examples of the former, and his whitethroats at Thomasville, Georgia, are examples of the latter. On the other hand, it can be stated that the percentage of returns is rather lower than might be expected. Many factors may account for this. To begin with, there is mortality. On the whole, where the balance of nature is not interfered with, the number of a given species is likely to remain the same from year to year; that is to say, the deaths tend to offset the births. It is believed that the period of greatest mortality among most birds is the time just after they have left the nest, before they have reached full strength

In the upper picture, taken by T. D. Carter, is shown a male Brewster's warbler. This bird, No. 48866, was captured at Wyanokie, New Jersey, three successive years: June 10, 1922, June 10, 1923, and June 15, 1924. On each occasion its nest was also located. Its mate was a golden-winged warbler (*Vermivora chrysoptera*) and one of their offspring is shown in the lower picture, taken by G. Clyde Fisher

or learned much wisdom. Even though they successfully survive this period, sooner or later some enemy will catch them or they will perish through the effects of the elements, for in nature there is no such thing as dying a "natural" death. Even so, nature's ruthlessness is often less cruel than our lingering kindness to our doomed sick ones.

Then there is the question of overcrowding on the breeding grounds.

Most birds that do not nest in colonies have a home area which they jealously guard from trespass by others of their kind, though often unconscious or careless of the presence of other species the habits of which do not conflict with their own. Thus a pair of kingbirds will hold their orchard against all other kingbirds, besides driving off hawks and crows, but will permit robins and bluebirds to nest there unmolested; while a single pair of kingfishers will patrol their stretch of creek to the exclusion of all others of their kind. No doubt if their young come back the next season to the same orchard or stream, there will be a battle, and the loser will have to look elsewhere for a home and a mate. Even so, a percentage of banded birds may be forced out of their home area, while unbanded birds will similarly filter in. A barred owl, one of four young banded in May, 1921, at Rhinebeck, was shot the following winter by a hunter a dozen miles away, where very likely it had taken up its abode after being invited to leave home by its parent, for it is not considered a migratory species. In this part of the country, the birds of prey seem to have fairly definite individual territory, due perhaps to the limitations of a particular food supply which must not be overtaxed. Barred owls have been present winter and summer near the writer's house for twenty-two years, but in winter there is at first only one bird, to be joined by another as the mating season approaches.

The writer's experience in bird banding has been limited by the time at his disposal chiefly to the trapping of winter birds. Chickadees and white-breasted nuthatches in abundance and a certain number of blue jays, purple finches, tree sparrows, and song sparrows have visited his traps and made interesting records. In spring he has seen banded nuthatches and chickadees entering their nests to feed their young within a few rods of the spot where they had been trapped. But the most continuous history he can relate from his own experience is that of the wintering juncos that have entered his traps since he started using them in January, 1920, after hearing Mr. Baldwin tell of his success.

The table on page 613 gives the number on the band of each junco which has returned in any season subsequent to that of its original capture, and gives every date on which it has been caught. Dates in parentheses are those occurring during the winter when the bird was "new," or first banded, and therefore do not constitute true returns. Dates not in parentheses indicate that the bird was captured during a previous winter, that it had gone away in the spring—how far? we wonder—and come back safely to the very spot where it had been fed before.

How many questions come up at this point! Why does the number of returns vary? Why have only three of the 1920–21 birds come back, and only one of those which were "new" in 1921–22? (This last one succumbed to the frenzy of a gray squirrel which got into the trap with it.) So far as trapping is concerned, the flock would appear to range in size between twenty-nine and forty-seven individuals. How much larger is it actually? How many juncos, in other words, avoid capture entirely? Is there more than one flock? Why did No. 27137 fail to register in 1920–21, seeing that in other years he has been so faithful? Was he absent, or was the winter so open that he found plenty of food outside the traps? If the latter was the case, he should have stayed away also in 1923–24.

CONDENSED RECORD OF BANDED JUNCOS

Year	1919–20	1920–21	1921–22	1922–23	1923–24
Character	Much snow	Very mild	Much snow and cold	Unusual amount of snow	Very mild till February
Number of Juncos Trapped	Old, 0 New, 29 Total, 29	Old, 3 New, 32 Total, 35 Old = 8.5%	Old, 5 New, 42 Total, 47 Old = 10.6%	Old, 6 New, 36 Total, 42 Old = 14.2%	Old, 7 New, 39 Total, 46 Old = 15.2%
Juncos That Returned					
No. 16150	(Jan. 16, 19, 21, 22; Mar. 16)	Feb. 27			
No. 27136	(Jan. 21)			Dec. 7; Mar. 6	
No. 27137	(Jan. 21; Feb. 24; Mar. 19)		Jan. 23; Feb. 3	Nov. 6; Jan. 28	Nov. 25; Dec. 2; Jan. 28
No. 46172	(Feb. 23)		Jan. 31; Feb. 4		
No. 46185	(Feb. 28)	Feb. 12	Dec. 5; Feb. 4		
No. 46195	(Mar. 18)	Dec. 25			
No. 29140	(Mar. 19)		Jan. 22; Feb. 4	Jan. 30	
No. 29142	(Mar. 20)		Jan. 31; Feb. 2, 3	Jan. 28	
No. 48207		(Feb. 12)		Nov. 5; Jan. 28, 29	
No. 48213		(Feb. 26)			Nov. 12, 15, 18, 26; Dec. 15; Jan. 4, 5
No. 6465			(Dec. 23; Jan. 20, 22)	Dec. 17, 18 died	
No. 48829				(Dec. 5, 11, 19; Jan. 26, 27, 28, 29, 31)	Nov. 13, 15
No. 48836				(Dec. 6; Mar. 10)	Dec. 14, 15, 16; Jan. 26, 28
No. 48845				(Jan. 26, 28)	Jan. 27
No. 6505				(Jan. 27, 28, 29, 30)	Jan. 26
No. 6510				(Jan. 27, 28)	Nov. 26; Jan. 28

Where was No. 48213 in 1921–22 and 1922–23? This last winter he has been caught seven times, having at so late a date acquired the "trap habit."

Quite different has been the experience with tree sparrows, although other banders report greater success. During the winter of 1919–20, twenty were banded. The following winter only three were caught, but all three were banded birds from the previous winter. In 1921–22 one of these three birds was recaptured and one new one, while yet another unbanded bird was seen. Since then only one or two tree sparrows have been noted anywhere near the writer's place in winter and none has been in his traps. What has become of the flock? Has it been wiped out? Or is it not likely that its regular headquarters are some distance away, that the deep snows of the first winter impelled the birds to pay the traps a visit and that a few remembered the place in subsequent winters, but that now they either have sufficient food or roam in another direction when it is scarce, no longer realizing where plenty lies awaiting them?

Photograph by R. H. Howland

This juvenal sparrow hawk (*Falco sparverius*), a female, was captured at Upper Montclair, New Jersey

Although we have now seen that "returns" are to be expected of old friends both in winter and in summer quarters, transients—that is, birds which nest north of us and winter south of us—have hitherto proved much harder to recapture. Not that they avoid the traps, for they are at all times tempted by suitable bait, but the captures are nearly always new birds, a circumstance which perhaps shows that migrating birds, until they reach their destination, alight for the day's rest and food in the first attractive spot they find after the light of

Photograph by G. Clyde Fisher

An immature red-shouldered hawk (*Buteo lineatus*) with a band on its leg.—It was caught near South Waterford, Maine, in August, 1923

day makes it proper and safe to halt. So it would be mere luck if the same transient ever stopped a second time in the same place during its semi-annual trip. However, even banding new transients brings its reward, for by keeping a record of those which "repeat," the arrival and departure of waves of migrants may be noted and their relation to meteorological conditions studied. Further, as more and more people along the main migration routes join in the banding, the probability of their catching birds that others have banded approaches a certainty.

It has been known for some time that certain species of birds, notably the herons, wander during the late summer before it is time to think of going south for the winter. Young birds seem especially prone to this habit and they are likely to wander north instead of south. Young black-crowned night herons were seen in late July and August in places where, it was known, they did not breed and to the north of which, it was believed, no heronries existed. The puzzle was definitely solved when some of the birds were shot by fishermen who objected to their feeding habits, and it was found that they bore bands placed on them in a heronry situated south of the place of capture. Doctor Cole, in the *Wilson Bulletin* for June, 1922, published two letters from men who had shot night herons and they are worthy of being reproduced in this connection:

"Gentlemen dear sirs Your bird was shot here to day by me Albert Bailey for which I was more than Sorry when I found it had a ring on. I took it for a Hawk as It flew several times over my yard as I thought after chickens and Gentlemen all I can say that I am sorry If I did wrong In so doing and also beg Pardon.

Yours with Rees
Albert Bailey."

"Gentlemen: The bearer of the enclosed was found in one of our traps yesterday morning. Now will you please tell us if you are raising these pests or did you simply capture and tag it to see how far it would migrate?"

Photograph by T. D. Carter

This song sparrow (*Melospiza melodia*), No. 24702, was first taken in a government trap on March 26, 1922, at Boonton, New Jersey. Up to July 22 of that year it revisited the trap no less than thirty-two times.

An astounding example of the extent to which a bird may wander was the finding of a common tern floating dead in the Niger River in western Africa. This bird had been banded in Maine! More amusing and less scientific was the report in a newspaper that "Wren Crosses Continent." Doctor Cole found that the facts in this case are as follows: Mr. Finley banded a wren in Oregon and it was later found dead in a watering trough in the same state. The band on its leg, however, read: "*The Auk*, New York, 3429," so the reporter assumed that the bird had flown nearly three thousand miles westward in its wanderings. In a recent lecture Mr. Howard Cleaves reported that robins banded in Canada and Iowa had been captured in Louisiana, and a meadowlark, banded in spring on Staten Island, New York, had been found in winter 180 miles south of its home, although the species winters in numbers on the Island. Banding should determine if the wintering birds do not come from farther north and whether all the breeding birds go south or not.

The banding of wild ducks in Ontario, Canada, and subsequent reports of birds shot during the autumn season by gunners, showed not only that sixteen per cent were shortly killed by man alone, but also that these ducks flew south by two different routes, part down the Atlantic Coast and part down the Mississippi Valley, while one bird, a blue-winged teal, was shot in Trinidad, off the coast of South America.[1] It is thought that bird banding will eventually show that there is actually a considerable east and west migration in certain species. An easy explanation is that such birds follow coast lines and rivers even when they deviate from a north and south line, and may thus stray many hundreds of miles from their original longitude, but there are other cases more obscure, which may be the result of habits formed in glacial times. Such a case is that of the woodcocks banded near St. Petersburg, Russia, which use three different routes in going south and winter in three different localities. Such also is that of the storks in Germany: those breeding west of the River Weser

[1] Lincoln, *Auk*, XXXIX, 1922, p. 329.

winter in Spain, while those nesting to the east go all the way to South Africa.[1]

A great deal more could be written of what can be learned by bird banding,—such as the progress of molts as noted in "repeating" birds, the replacement of accidentally lost tail feathers, whether birds use scent or sight in picking out food (why does a chickadee gobble up cracked peanuts which it has probably never seen before and neglect the other more familiar seeds offered to him?), the effects of parasites and bird diseases,—for instance, that malady which had attacked the feet of chipping sparrows caught by Mr. Baldwin in Thomasville. The building of suitable traps is a study in itself, so as to attract species which will not enter the ordinary "fly-trap" types and drop traps. No doubt the surface of the subject has only been scratched, and banders in future will find so much to interest them that some may have to specialize along certain lines of study to the exclusion of others. Incidentally, every new bander becomes a bird protectionist, feeds his charges, and keeps vermin and trespassers away. Ordinary care in the handling and watching of traps makes accidents to birds rare and unlikely events.

Some one has suggested the motto, "Let us band together." The writer feels sure that a trial will prove the game is not only worth while but actually absorbing and fascinating.

[1]Oberholser, *Auk*, XL, 1923, p. 438.

Photograph by Arthur A. Allen

A banded green-winged teal (*Nettion carolinense*) and canvas-backs (*Marila valisineria*) at a feeding station, Ithaca, New York

NOTES

EDMUND OTIS HOVEY

Dr. Edmund Otis Hovey, curator of the department of geology in the American Museum of Natural History, died suddenly September 27, 1924. He was sixty-two years of age and had been a member of the Museum staff for more than thirty years. The scientific staff of the Museum adopted on October 14 the following minute and resolution:

Doctor Hovey was appointed as assistant curator in the department of geology on January 1, 1894, and was second to Doctor Chapman in order of seniority among the curators of the Museum. He was appointed associate curator in 1901 and curator in 1910.

His time in his earlier years at the Museum was largely given to the cataloguing and exhibition arrangements in the department. The catalogue of types and figured specimens of fossils in the department collections, a volume of 500 pages, was completed and published in 1898–1901 in collaboration with Doctor Whitfield. Doctor Hovey's principal contribution in later years has been the series of relief maps illustrating various typical phases of physiographic geology. These maps, carefully studied and planned in advance, and executed with a high order of accuracy and scientific insight into the processes that they illustrate, are regarded as exceptionally instructive and reliable. Artistically and technically they are far above the ordinary type of relief map, constituting a permanent contribution of solid merit to the science of geology.

Editorial Service.—Doctor Hovey was editor of the American Museum Journal (now Natural History) for the first ten years of its existence from 1900 to 1910, and continued up to the time of his death a valued adviser and contributor to its pages. He was editor of the *Annals of the New York Academy of Sciences* from 1908–16, supervising the nine volumes published during those years. At the beginning of this year (1924) he undertook, with some reluctance, the editorship of the scientific publications of the division of geology, palæontology, and mineralogy in the Museum. He had organized and initiated this editorial work and was busied with it in his last days.

Studies of Volcanoes.–Doctor Hovey had for many years been especially interested in volcanic phenomena, had studied some of the volcanoes, living and extinct, of Europe, and in 1902, 1903, and 1908 spent considerable time in Martinique and St. Vincent, making a scientific study of the great outbreaks of Mont Pelée and the Soufrière. The preliminary results of this study were published in the American Museum *Bulletin* and in the *Proceedings of the Vienna International Geological Congress*. When the news arrived of the utter destruction of St. Pierre, he took the first boat for the West Indies, leaving upon a few hours' notice and, arriving at the islands while the eruption was still in full force, was an eyewitness of many of its most impressive and remarkable phenomena, and secured an important series of photographs and observations. His later visits enabled him to record the waning activities of the volcano and subsequent changes, and he was planning to make a final visit next year to correct and check up various details and note the changes of twenty years before publishing a final memoir upon the eruptions.

Arctic Exploration.—Doctor Hovey had long been interested in Arctic exploration, was a director of the Explorers Club, and as chairman of the committee in charge of the Crocker Land Expedition of the Museum, took an active part in its organization and equipment. A succession of misfortunes and difficulties which befell this expedition made it desirable for him to go personally upon the relief expedition sent out in 1915, and this in turn met with unexpected difficulties which enforced a prolonged stay of nearly two years in the camp at Etah. Since his return he had made a series of field trips in connection with the physiographic relief maps planned and under way, and at the time of his death was about to leave for a trip to southwestern Texas to study the details of the Van Horn model.

Secretarial Service.—Doctor Hovey was for fifteen years (1907–22) the secretary of the Geological Society of America, and was very largely concerned with advancing the growth and prosperity and maintaining the high standards of that great and influential association of working geologists. The high value placed by his associates upon his services to American geology was evinced in an address and loving cup presented upon the occasion of his retirement in 1922. He was also recording secretary of the New York Academy of Sciences from 1907–16. Here also the value of his highly competent and efficient service was greatly appreciated by his fellow members. He was a regular attendant at the International Geological congresses from 1903 until their temporary cessation during the war period, taking an unostentatious but always influential part in the discussions and proceedings of the congress. As delegate from the Museum he attended in 1920 and 1923 the Pan-Pacific congresses in Hawaii and Australia respectively.

Doctor Hovey's wide personal acquaintance among geologists, and the respect entertained for his knowledge, experience, and judgment, enabled him to do much to advance the influence of the American Museum both at home and abroad. His colleagues have learned through many years of collaboration to value his straightforward honesty of mind and purpose, his unselfish devotion to the interests of the Museum and of science, his fair-mindedness and temperate expression—and his death leaves us all with a deep sense of personal loss.

Be it therefore resolved that the scientific staff of the Museum desires to record its deep appreciation of Doctor Hovey's character and services and to mourn the passing of this colleague and friend as a heavy loss to the Museum, to science, and to the large circle of his associates and steadfast friends.

THE PASSING OF THE "ALBATROSS"

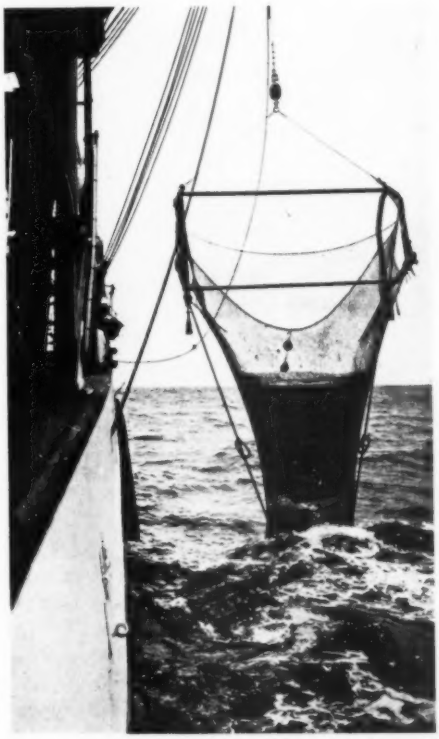
After nearly forty years devoted to oceanography and fishery service in Atlantic and Pacific waters, the steamer "Albatross," a twin-screw, brigantine-rigged vessel of 1100 tons displacement, has passed out of the control of the Bureau of Fisheries.

Her career as a deep-sea exploring ship has been a notable one. With her launching in 1883, the field of marine investigations of American naturalists was extended from the shallow waters of coasts to almost the greatest known depths of the sea. During three long cruises in the tropical Pacific under the direction of Alexander Agassiz, dredging was carried on in deeper water than ever before, animal life being brought up from a depth of 4173 fathoms (more than four and a half miles). Her deepest sounding was 4813 fathoms (nearly five and a half miles). Agassiz described her as "the best deep-sea dredger in existence," and later wrote, "I can hardly express my satisfaction at having had the opportunity to carry on this deep-sea work on the 'Albatross.' While of course I knew in a general way the great facilities the ship afforded, I did not fully realize the capacity of the equipment until I came to make use of it myself. I could not but contrast the luxurious and thoroughly convenient appointments of the laboratory of the 'Albatross' for work by day and by night with my previous experience."

Never actually out of commission except for a year or more before her sale, her record of service includes, besides many winters devoted to deep-sea investigations in tropical waters, long summers spent in surveying northern fishing banks, remote Alaskan harbors, and the estuaries of valuable salmon rivers, fur-seal investigations in Bering Sea, surveys of the California-Hawaiian cable route, and gunboat service during two wars.

While dredging was done in the deeper waters adjacent to all fishing grounds investigated, there were many voyages for purely oceanographic research. The oceanic regions included in such explorations were the western Atlantic from Newfoundland and southward through the Caribbean Sea to the Strait of Magellan; the eastern Pacific off the coasts of North, Central, and South America; the tropical Pacific through Polynesia to Japan; and the western Pacific from the Japanese Archipelago to China, the Philippines, and Borneo.

If ever the American people received the fullest possible value from a government ship, they received it from this one. The benefits to science, the fisheries, and commerce springing from her almost continuous investigations —the results of which have all been published and widely distributed throughout the world



Photograph by C. H. Townsend

The beam trawl of the "Albatross" coming up from a depth of 1760 fathoms (two miles)

—are incalculable. The results of her deep-sea work—overshadowed, it is true, by those of the famous "Challenger" Expedition, which were embodied in fifty quarto volumes —would assume even larger proportions could they have been published in the same uniformly sumptuous style as those of the "Challenger." The "Challenger" was a pioneer ship in oceanographic work and must remain the leader in the literature of the science. The "Albatross" entered the field much later, but thanks to her more modern equipment and longer service, her collections were naturally much more extensive and the bulk of her published results was perhaps

also greater.[1] Comparisons are not in order, but it is of interest to record that once from a depth of 1760 fathoms (two miles) the "Albatross" brought up more specimens of deep-sea fishes at a single haul of the dredge than the "Challenger" collected during her entire period of service. The writer and his assistants counted them at the time and, having the "Challenger" reports on board, looked up the record. There are in the National Museum and in the widely scattered laboratories of specialists many "Albatross" deep-sea collections awaiting examination. While serving as resident naturalist of the ship, the writer sorted, packed, and shipped to the Bureau of Fisheries and to research workers in museums and universities at home and abroad, actually carloads of *Spolia Albatrossia*.

Naturalists connected at various times with the scientific staff of the "Albatross" were Agassiz, Mayor, Kofoid, Bean, Jordan, Gilbert, Evermann, Bigelow, Sumner, and more than a score of others. The writer, after several agreeable years on board, reluctantly left the ship when assigned to duty at headquarters. Among the score of naval officers detailed to the "Albatross" during her earlier years of service were many now on the list of rear admirals, including Benson, Rodman, Eberle, Wilson, Hughes, Burrage, Anderson, and Johnston. Captain Tanner, her notably efficient and devoted first commander, contributed more than any one else toward the perfecting of the vessel's equipment.

Occasionally a beam trawl-net was torn away by the weight of its load, but I do not recall a single break in the five-mile-long wire cable. Tanner was a master at this sort of work but succeeding naval commanders learned to do the task as well. It was reserved for Captain Moser to make the deepest successful haul—more than four and one half miles—and all accomplished in ten hours. Think of reaching that far down through the darkness of the ocean for a load! Imagine an air-ship similarly equipped and miles above the earth letting down a cable in the nighttime for a haul from the surface of the earth!

In spite of its four decades of service the "Albatross" is still stanch and seaworthy. It is to be regretted that funds could not have been found for the continuance of her deep-sea investigations, for which no vessel is better fitted. The Commissioner of Fisheries told me that any qualified group of American scientific men could have had her for the asking. Her buyer says she will not be broken up.[2]—C. H. Townsend.

[1] A bibliography of the "Albatross," compiled by the writer in 1901, contained nearly three hundred titles, including documents in preparation; since then, the number has been more than doubled. Many of the publications on the results of dredgings by the "Albatross," more particularly those issued by the Museum of Comparative Zoology, are large quartos superbly illustrated.

CONSERVATION

The Gorilla Sanctuary An Accomplished Fact.—A large area, embracing 250 square miles, has been set apart in the Lake Kivu district of Africa as a sanctuary for the gorillas and other wild animals that inhabit it. Protection will be extended even to the flora, so that for all time the natural features that lend interest to this region may have an unimpaired appeal for the visiting naturalist. The reserve is situated in the northeastern part of the Belgian Congo between Lake Kivu and Uganda and includes the three volcanoes—Mount Mikeno, Mount Kirisimbi, and Mount Visoke. It is the region described in the article "Gorillas—Real and Mythical" contributed by Mr. Carl E. Akeley to the issue of Natural History for September–October, 1923.

Impressed with the unique interest of this locality—for nowhere else in the world can the great apes, regarding which man has still so much to learn, be studied to better advantage—Mr. Akeley on his return from Lake Kivu made it his aim to secure the proper protection for the gorillas still surviving in the area. The establishment of Albert National Park (Parc National Albert) marks the consummation of his zealous effort. Accompanied by Dr. W. K. Gregory and Dr. J. H. McGregor of the American Museum, and by Prof. F. Tilney of the College of Physicians and Surgeons, Mr. Akeley went to Washington and convinced the Belgian Ambassador, Baron de Cartier de Marchienne, of the unusual opportunity within the grasp of his country to serve science through the creation of a gorilla sanctuary. His Excellency, who was then on the point of sailing for Belgium, became the enthusiastic advocate of the proposal abroad, pleading with such effectiveness that he finally succeeded in achieving his purpose. Seconding his efforts,

[2] An interesting coincidence in connection with the passing of the "Albatross" was the sale of the "Hirondelle," the splendid steamer built by the late Prince of Monaco for oceanic research. In accordance with the terms of his will, the proceeds from the sale of the vessel were applied to the endowment fund of the Oceanographic Museum at Monaco, which he founded.

with unrelaxing devotion, was the Belgian Consul at Baltimore, Mr. James G. Whiteley.

Thanks to the vision and persistence of those interested in the realization of this plan, and of Mr. Akeley in particular, who first conceived it, the gorilla sanctuary awaits only the definite demarcation of its boundaries and the signature of King Albert before being formally proclaimed a national park.

NEW GROVES ACQUIRED BY THE SAVE THE REDWOODS LEAGUE.—On August 24, the Franklin K. Lane Memorial Redwood Grove, a beautiful two-hundred-acre tract of giant trees on the Redwood Highway, at Kettintelbe (Phillipsville), sixty-five miles south of Eureka, in Humboldt County, California, was dedicated with suitable ceremonies. The grove was acquired through a fund contributed by a group of friends of Franklin K. Lane, headed by Mr. E. E. Ayer of Chicago. In addition to its magnificent stand of redwoods this grove has areas suitable for camping and the privilege of using these for the purpose will be extended to the public.

The Save the Redwoods League announces also that through a generous gift from Mr. G. Fred Schwarz of New York, supplemented by funds supplied by the League from dues and contributions of members, it has acquired a splendid tract, 157 acres in extent and containing more than 12,000,000 feet of redwood, located on the Redwood Highway, ten miles south of Crescent City.

A MUSEUM FOR THE YOSEMITE.—A grant of $75,000 has been made available through the Laura Spelman Rockefeller Memorial for the erection of a museum building in the Yosemite National Park, for its equipment and furnishing, and for the maintenance, during the first three years of its existence, of the personnel in charge. The plan contemplates the eventual absorption of the museum by the National Parks Service and the establishment of similar local museums in other national parks.

The maintenance of museums in our parks is not an untried experiment. In fact, last year more than 55,000 people visited the shack in the Yosemite that tentatively housed the nucleus of the collections planned for instalment in the building now made possible. In other parks, too, the foundations have been laid of what promises to be a movement of far-reaching educational importance. It is particularly fitting that museums should find place in our national parks, where thousands upon thousands of individuals annually spend their holidays. With their curiosity stimulated by the wonders of nature surrounding them on all sides, they have the chance through the exhibits of the museum to gain authoritative information regarding the local rocks and stones, the characteristic animals of the area, the flowers that grow in rock cleft or stream-bordering meadow, and the Indians who were the original discoverers of the region long before the days of the white man.

All of these phases of interest will, as the plan develops, be represented in the prospective building in the Yosemite. It is not contemplated, however, to make the museum a substitute for the park but rather a key to its features of interest. In furtherance of this purpose it is proposed to label the trees of the park and to mark geologic formations that are especially worthy of attention.

The American Museum represented on the committee in charge by Dr. Clark Wissler, vice chairman, by Honorary Director Frederic A. Lucas, and by Mr. George D. Pratt, one of its Trustees.

THE PAUL J. RAINEY WILD LIFE SANCTUARY.—The name of Paul J. Rainey was certain to have an abiding place in the memory of those interested in wild life through the part he played in first making known to the stay-at-home population the interesting habits of African game animals as revealed by the motion-picture camera supplemented later by pictures no less interesting of animal life in the Arctic Circle. In yet another way his name will henceforth be linked with the preservation of the records of nature. Forty square miles of territory in Vermilion Parish, Louisiana, have been presented to the National Association of Audubon Societies by Mrs. Grace Rogers, Rainey's sister, with the stipulation that they be maintained in perpetuity as a haven for birds, to be known as the Paul J. Rainey Wild Life Sanctuary. The land is bounded on the east by the State Wild Life Refuge and on the west by the hunting marshes of Edward A. McIlhenny.

Not only will the hunter be kept out of the guarded area, but through the immediate planting of duck foods in large quantities, every allurement will be offered to birds to enter it.

THE BIOLOGICAL SURVEY SOLICITS AID.—Have migratory wild fowl been increasing or decreasing in number during the last few

years? Drainage has deprived them of needed water and has resulted in their concentration in undrained areas, thus making for density of bird population in some places with corresponding sparsity in others. Accurate figures are needed regarding the various species not only of water fowl but of other migratory birds in order that the Migratory Bird Treaty Act and Regulations may be efficiently administered. To this end the Bureau of Biological Survey solicits detailed reports of observations, particularly of wild ducks and geese, dating from 1913, when the first migratory bird law became effective, or from any year subsequent thereto when notations were commenced by the individual observer. The reports should contain special reference to the annual increases or decreases and to the condition of the habitat of the birds. They should include a statement regarding the opportunities the individual has had to make observations and the dates when and the places where they were made. A questionnaire is furnished by the Bureau of Biological Survey covering the points of special interest and value.

BIRDS

THE EXTINCT CUBAN MACAW.—Through the generosity of Dr. Thomas Barbour the American Museum has come into the possession of a specimen of the extinct Cuban macaw (*Ara tricolor*). Only four specimens of this bird are represented in American collections, one being in the Museum of Comparative Zoology and two in the National Museum, the newly acquired specimen making the fourth. Nor have the museums of the Old World a representation noticeably better. Five is the number of specimens mentioned in Rothschild's *Extinct Birds* as the ascertained total in European collections, though the author adds that there are probably others of which he is not aware.

Ara tricolor, formerly confined to Cuba and the Isle of Pines, became extinct as long ago as 1864 when apparently the last specimen was shot at La Vega. Like all the West Indian macaws it was ruthlessly sought for food until its extermination resulted, its striking plumage failing to restrain the hand of the destroyer; but while the other West Indian forms were blotted out, not a specimen remaining to serve as a reminder of their former existence, the Cuban macaw survives at least in the form of a decimated remnant of museum specimens.

To his valued gift of the macaw Doctor Barbour has added that of another rare bird, the extinct New Zealand blue duck, associated with the mountain torrents of that country. This duck (*Hymenolaimus malacorhynchus*) is remarkable from two standpoints: its individuality of structure has earned it the status of a monotypic genus, while its bluish gray color is unique among ducks and swans.

THE NEW YORK AQUARIUM

REPORT OF THE DIRECTOR FOR 1923.—To one unfamiliar with the difficulties of maintaining captive fishes in a healthy condition the equipment that is necessary and the care that must be exercised are in the nature of a revelation. In the tanks of the New York Aquarium there were at the close of 1923 no less than 3727 specimens representative of 116 species. Many of these came from Sandy Hook Bay and it might at first thought seem that the harbor water would answer their needs. But because of its low salinity and its increasing pollution, this water would be a menace and the Aquarium is therefore dependent on its reservoir of pure sea water to supply the needs of the marine fish entrusted to its care. Many of the fish come from the tropics and require water of a temperature higher than that obtaining in northern seas. In consequence water supplied to these fishes has to be artificially warmed. Lake and river fishes need non-saline water, and in the case of trout and other northern forms this water must be artificially cooled during about five months of the hot spell.

To meet these several requirements the New York Aquarium has four water systems, with ideal equipment for circulation, filtration, aëration, heating, and cooling. Constant vigilance is required to guard against accidents and to this end employees serve in eight-hour watches, guarding pumps and filters, taking the temperature of the water, and observing its flow.

During the past year the attendance at the Aquarium totaled 1,813,647,—greater by nearly 400,000 than the number of individuals that visited the American Museum during the corresponding period. Even so, the number of visitors to the Aquarium was nearly 300,000 less than in 1922, the explanation being the greater inconvenience occasioned by the extensive renovations of the Aquarium building. These renovations, when completed, will, however, greatly enhance the attractive-

ness and substantiality of the setting, in addition to making more space available for exhibition purposes, and it is safe to predict that the influx of the public through the iron-studded doors that commemorate the former use of the building as a fortress will in the future be greater than ever.

The interest of the Aquarium is not only in its fishes. At the close of the year it housed in addition 99 aquatic reptiles, representing 18 species, 58 amphibians of 8 different species, 544 invertebrates, belonging to 16 species, a marine mammal, and two water birds from the Galápagos Islands,—a penguin (*Spheniscus mendiculus*) and a flightless cormorant (*Phalacrocorax harrisi*).

The services rendered by the Aquarium are not confined to the exhibition of specimens. It has helped other communities plan aquaria, has through exchanges and gifts furnished specimens to other institutions not only in this country but abroad, has supplied during 1923 no less than 800,000 whitefish fry to Lake Champlain, 100,000 yellow perch fry to Prospect Park Lake, Brooklyn, and sundry thousands of trout fingerlings to Palisades Interstate Park, and finally through the written contributions of its scientific staff—notably the illustrated article on "Our Heritage of the Fresh Waters" prepared by Director Charles H. Townsend for the *National Geographic Magazine*,—has disseminated knowledge of many of the interesting forms represented in the institution at Battery Park.

MAMMALS

Mr. George G. Goodwin of the department of mammalogy, American Museum, has presented to the institution 162 mammals which he collected in New York State during his vacation. The first specimens were taken at Berlin, on the Massachusetts border, and included a series of smoky shrews (*Sorex fumeus*)—a species hitherto unrepresented in the Museum collection—a water shrew, and a fine series of woodland jumping mice (*Napeozapus*). From Berlin Mr. Goodwin went northward by automobile, passing the southern end of Lake George and proceeding thence up the valley of the Hudson River to Minerva. From Minerva he followed a trail for eighteen miles that led through wooded country and it was here that he secured several larger animals including beaver and raccoons.

REVIEWS

"Founders of Oceanography."—About a year before his death on July 26, 1924, Sir William Herdman wrote in the preface of his *Founders of Oceanography*[1]: "I have myself lived through the period that has seen the development of the Natural History of the Sea into the Science of Oceanography, and have known intimately most of the men who did the pioneer work."

Among the founders of the science of the sea, he speaks at length of Prof. Edward Forbes, Sir Wyville Thomson, Sir John Murray, Alexander Agassiz, and the Prince of Monaco. When the next volume on oceanography is written, the work of Sir William Herdman himself will constitute an important chapter.

We have read his admirably written book with such absorption that it is fitting, in describing it, to use as far as possible the language of the author. In his chapter on Forbes he says "the best description in brief form is that he was the pioneer of oceanography." Thomson's name, he very properly states, "will go down through the ages as the leader of the famous Challenger Deep-sea Exploring Expedition." Murray's period was continuous with that of Thomson. It fell to his lot to complete the work of Thomson, the two having guided the destiny of the greatest single undertaking of oceanographic exploration. To Murray's tremendous energy must be credited the excellence of the fifty quarto volumes constituting the incomparable "Challenger" reports. This expedition was a national undertaking.

As outstanding examples of the enterprise of private oceanographers, Sir William selects two names—those of Alexander Agassiz and the Prince of Monaco. Both of these men devoted most of their lives and much of their private fortunes to marine explorations, and their investigations and sumptuous publications carried forward without pause the development of the new science of oceanography. Agassiz' work was done with both government and private vessels, while the Prince of Monaco built three vessels for marine investigation, each larger and more perfectly equipped than its predecessor. He also founded and endowed the Oceanographic Museum at Monaco and the Oceanographic Institute at Paris.

[1]Longmans, Green & Co., New York, 1923.

The science of oceanography has gained much during the last half century from observations made at biological establishments on shore. The author naturally devotes most of the chapter regarding these stations for marine research to the celebrated Stazione Zoologica at Naples and to Anton Dohrn, "the founder, benefactor, director, the centre of all its activities, the source of its inspiration." There is no other laboratory where the study rooms are occupied by investigators of established reputation from all parts of Europe and America, attracted by the fame of the institution and its director. Its Aquarium on the ground floor is one of the sights of Naples.

All of the first seven chapters are filled with interesting details respecting the men, the ships, and the laboratories that have contributed to the creation of the modern science of the sea. The succeeding chapters—more than half of the book—are devoted to the physical characteristics of the oceans, under such headings as hydrography, ocean currents, plankton, submarine deposits, coral reefs, the sea-fisheries, etc., all discussed by a master in oceanography who has devoted a lifetime both afloat and ashore to gaining a knowledge of the sea.

To the plankton, which no one has studied more assiduously than Herdman himself, two chapters are devoted. The name is used to include all the small animal and plant organisms that drift about in the sea. The importance of the plankton in the scheme of nature can scarcely be overstated. Abundant in most seas, its innumerable and varied organisms constitute the food of young fishes of many kinds and also of great schools of migratory fishes such as the herring and mackerel. The luminescence of the sea surface is due largely to light-producing organisms composing much of the plankton. There is not space here for remarks on such important chapters as applied oceanography, the fisheries, and food matters in the sea.

The present writer had the privilege of knowing Herdman in Washington when the specimens obtained by some of the Pacific dredgings of the "Albatross" were being unpacked. Later on there were pleasant meetings in New York in company with the late Doctor Mayor.

Like his associates in oceanography, Murray, Agassiz, and "Monaco," Herdman devoted much of his private fortune to the furtherance of marine investigations. His sudden death, just as he was about to start for the meeting of the British Association for the Advancement of Science, is a matter of profound regret. In the book he has left us, we have the most recent summary of oceanographic science.—C. H. Townsend.

"Woodland Creatures" by Frances Pitt.—A book of intimate studies of some of the forest-dwelling mammals and birds of the British Isles has just been issued under this title by E. P. Dutton and Company. The author is not only a keen and independent observer of animals in the wild but at great pains she has reared at various times all of the mammals and several of the birds she describes, so that her sketches, in addition to revealing a comprehensive background of woodland knowledge, have the special interest that attaches to the biographies of individual animals. The badger, the dormouse, the fox, the rabbit, and the squirrel are each assigned a chapter or more, while alternating with the accounts of these mammals are chapters devoted to the woodpeckers, the bullfinch, the sparrow hawk, the kestrel, various owls, and the magpie and the jay. The book is attractively illustrated.

"Outwitting the Weasels" by Helen Harrington.—Two plays adapted by Helen Harrington from stories by Clara D. Pierson have recently been issued by E. P. Dutton and Company. Both of them are well suited for presentation by children and both inculcate wholesome ideas in a non-didactic, humorous, and delightful way. "Outwitting the Weasels," one of the two plays, has as its theme the protection of the birds—on the one hand, from the deliberate aggressor, represented by the boy with the sling; on the other hand, from that slipshod negligence, unfortunately not confined to childhood, which fails to replenish the empty drinking fountain or provide other necessities upon which the birds have come to depend.

THE BRITISH ASSOCIATION MEETING

For the fourth time in its history the British Association for the Advancement of Science, which was founded in 1831, held its annual session in Canada. The Toronto meeting opened on August 6, under the presidency of Major-General Sir David Bruce, K.C.B., F.R.S., the successor in office of Prof. Sir Ernest Rutherford, F.R.S., and was attended not only by many scientists from the Old

World but by Canadian savants and representatives from the institutions of learning in the United States. Through the papers read before the several sections and their subsequent discussion opportunity was given for a broad interchange of knowledge.

The American Museum was represented at the gathering by President Henry Fairfield Osborn, who took part in the sections of zoölogy and anthropology, and by Dr. W. K. Gregory, who participated in the discussion regarding "The Origin of Land-living Vertebrates" and presented before two of the sections a paper, prepared in collaboration with Dr. Milo Hellman, on "The Dentition of *Dryopithecus* and the Origin of Man." Although unable to be personally present, Dr. William Diller Matthew contributed an account of his recent find in Texas under the title of "A New Link in the Evolution of the Horse." A paper by Dr. Clark Wissler on "The Segregation of Racial Characters in a Population" was presented by title.

The Museum has had the privilege of welcoming a number of the delegates on their way to and from the British Association gathering. Among those who visited the institution and established contact with its scientific staff may be mentioned: Prof. E. S. Goodrich, of Oxford, and Mrs. Goodrich, Mr. F. A. Bather, who has recently succeeded Sir Arthur Smith Woodward as keeper of geology, British Museum (Natural History), Prof. J. T. Cunningham, Prof. W. J. Dakin, Prof. Walter M. Tattersall, of Cardiff, Doctor Pritchard, of Melbourne, Australia, Prof. George Hickling, Dr. Clarence Tiveney, Dr. C. C. Hentschel, Dr. Kenzo Iguchi, of the Imperial University, Sapporo, Japan, Lady Henderson, Dr. Cuthbert Christy, Prof. J. W. Gregory, of the University of Glasgow, and Prof. D. M. S. Watson, of University College.

COMPARATIVE ANATOMY

Dr. Heichiro Motohashi, of the Imperial College of Agriculture, Tottori, Japan, has been in attendance at the American Museum, studying the osteology of the wild asses of Asia and using for the purpose skulls and skeletal material obtained by the Third Asiatic Expedition.

ASIA

Hunting the Sumatran Rhinoceros.—In the July-August issue of Natural History, p. 527, allusion was made to a cable sent by Mr. Arthur S. Vernay in which he announced that he had secured a female and young male of the rare Sumatran rhinoceros (*Dicerorhinus sumatrensis*). In a letter dispatched by Mr. Vernay a full report of this achievement, which he describes as the *grand coup* is given. These rhinos are very carefully protected because of their scarcity and it was only thanks to the generous interest that Sir Harcourt Butler, the governor general of Burma, has taken in the expedition that permission to secure specimens for the American Museum was accorded. The district chosen for the hunt was the Pegu Yomas, a rough, precipitous region of shale and sandstone, in the south-central part of Burma. Arrangements for the successful prosecution of the hunt were made by Mr. Hopwood, the conservator of forests, Tenasserim Circle, sixteen elephants being provided for transport and a detail of six military police mounted on ponies being ordered to accompany Mr. Vernay.

The plan of campaign was to work up each of the main streams that flow into the Pegu River, in the hope of coming upon wallows, and also to explore in similar fashion each of the feeders of these streams. For six days a careful survey of the country was made without revealing the presence of a dark form. On one occasion the party came upon a wallow that had been used twenty-four hours before. They settled down near it to await the possible return of the animal that had used it but although they lingered till the late evening, no rhino appeared to reward their vigil.

On the seventh day the party scoured country covered with creeping bamboo, a favorite food of elephant and rhino. The going was exceedingly difficult and not even a rhino track was discernible as compensation for the arduous search. Time was getting on and it was decided to make for camp. The way thither lay along a stream known as the Bahmalik Chaung. Mr. Vernay writes:

> After a mile or so we found that the water in the stream was suddenly tinged with mud. We followed the discolored water upstream for 475 yards and ascertained that a feeding stream that flowed into the Bahmalik at that point was responsible for the brown tinge. Beyond the feeder the water in the Bahmalik was clear. We discussed the matter and came to the conclusion that the muddy discharge must be due to one of three things: (1) a local rainstorm, (2) a landslide, (3) elephants wallowing—the discoloration seemed too heavy to be caused by rhinos. Although the

Photograph by Arthur S.Vernay

A rough climb along the course of a muddy mountain stream to ascertain whether the brown discoloration of the water was due to a local rainstorm, a landslide, or a wild animal wallowing

Photograph by Arthur S. Vernay

One of the rewards of the effort depicted in the upper photograph.—This little rhino (*Dicerorhinus sumatrensis*) was adopted by Mr. Vernay and the other members of his expedition. The tiny fellow came to feel quite at home in the bamboo enclosure set aside for his use

hour was late, an occurrence such as this needed investigation.

We started up the little stream. The ascent was difficult, even formidable, and to us in our impatience to reach the goal the climb seemed interminable. After a time there appeared in front of us a stretch worse than any we had previously traversed. The water was now very thick. It confirmed our conclusion that there must have been a landslide and, as we were feeling very weary, we sent our two natives up to investigate. These men climb like cats and soon were lost to sight.

After ten minutes or so they reappeared gesticulating wildly. We knew that the big moment had come. Slowly we made our way up. We wanted to save our breath for the final effort, when steadiness of aim is all-essential. At length we reached our natives. They informed us they had heard a grunt. We listened, and presently we too heard a sound that meant rhino.

The way beyond was narrow and steep. We thought that over the top of the rocks about twenty yards above us there must be a flat place, for beyond was an old landslide. We wanted to have a look at this flat place without being observed ourselves. As there was room for only one individual at a time, I led the way and Percy-Smith followed close behind. I clambered to the spot and with the utmost care peeped over. Not ten yards away was a rhino in a wallow. I pulled back, fortunately found a place that offered good support for my feet, and then straightened up again. As I came into view this second time the rhino—a female—saw me. She made one plunge, when a lucky shot in the brain killed her.

As Mr. Vernay approached the wallow, a small object emerged from behind the fallen animal. It was a baby male rhino about one month old. It charged viciously but ineffectually. This little rhino was transported to camp in a bamboo basket, quickly and skillfully made by the two natives. It took milk out of a bottle and was a camp pet for several days. It was then sent to Rangoon, to be placed in the Zoo. But it did not survive and, as a consequence, it will be mounted with its mother in an American Museum group.

THE DINOSAUR EGGS.—The famous dinosaur eggs collected in Mongolia last summer by the Third Asiatic Expedition have recently been prepared for exhibition and are now on view. They belong to nine different groups and show considerable variation in size and surface markings. The largest and by far the most important group consists of thirteen eggs in the rock, two weathered out but still intact, and at least two more represented by broken shells lying on the surface near the nest. President Henry Fairfield Osborn is to give the general scientific description of the eggs and the microscopic study of the shells is to be undertaken by Dr. Victor Van Straelen of the University Libre of Brussels. Doctor Van Straelen has recently published a paper regarding the structure of some fragments of supposed dinosaur eggs from the Cretaceous of southern France and is well equipped for the task assigned to him.

Plaster casts of three of the Mongolian eggs have been made and sets have been sent to the following institutions: Geological Survey of China, Peking; British Museum, London; Natural History Museum, Brussels; U. S. National Museum, museums of Yale, Princeton, the University of California, and the State University of Iowa, Buffalo Society of Natural Sciences, and the Cincinnati Zoological Park Association. Also a single cast has been sent to each of the more important museums of Australia.

HISTORY OF THE EARTH

THE GEOLOGY OF GREENLAND.—A contribution by Dr. Edmund Otis Hovey, late curator of geology and invertebrate palæontology, American Museum, is printed as the leading article in *The American Journal of Science*, Fifth Series, Vol. VIII, No. 45. It is entitled "Geology of Northwest Greenland and Its Relation to the Flora, Fauna, and People of the Region" and is a timely article on an area which at the present time is attracting attention in connection with the recent return of Captain Donald B. MacMillan from its fastnesses. As the head of the party sent out to relieve the Crocker Land Expedition, Doctor Hovey gained knowledge at first hand of Greenland and its phases of interest, and this knowledge has been supplemented by extensive and painstaking reading. As a result his article gives an informing picture of this Arctic land where the conditions of life are comparable to those along the edge of the continental glacier during the Ice Age. The account closes with this significant statement:

"The recent possession of firearms by the Eskimo has exterminated caribou from the southern portion of the Smith Sound area and restricted the musk ox to the more inaccessible north coast of Greenland and the wilds of Ellesmere Land to the west, while it already threatens the numbers of seal and walrus in the sea and the polar bear on the sea ice. The possession, furthermore, of the steel trap at

the same time imperils the existence of the fox and the hare. If these animals be eliminated from the country through these improved agents of destruction which the Eskimo obtains through barter with the white man, the Eskimo too must disappear unless he is supported by his civilized brother. The Danish trader has to some extent replaced caribou and musk ox hide with imported reindeer hide, but the contribution of the seal, the walrus, the hare and the fox to human life will never be made good by anything that the white man is likely to furnish in the way of food and suitable clothing. The balance of nature will be disturbed and the amelioration of existence which has led to the increase of population in the present day Polar Eskimo will result in his ultimate extermination."

DR. CHESTER A. REEDS, associate curator of invertebrate palæontology, American Museum, was elected an honorary member of the Sociedad Geografica de Colombia at the session held on June 27. Doctor Reeds' proposer was the president of the society, Don José M. Rosales.

DR. KURT EHRENBERG of the University of Vienna, and Mrs. Ehrenberg, have been for some weeks guests of the American Museum, where Doctor Ehrenberg has been studying on the one hand the fossil invertebrates, with a view to determining their adaptations to a sessile life, and, on the other, the osteology of the bears, with special reference to the cave bear. Doctor Ehrenberg is the son-in-law of Dr. Othenio Abel, whom the Museum will have the pleasure of greeting in February, 1925.

EUROPEAN PREHISTORY

PLIOCENE MAN.—The Osborn Library has lately been favored with several new publications by Mr. Reid Moir of Ipswich, England, describing his most recent work in the Red Crag and related deposits of East Anglia. The American Museum two years ago contributed funds to Mr. Moir's investigation at the famous Foxhall station[1] and in due time received a share of the recovered specimens, which are now on exhibit in the hall of man. The finds of 1922, figured and described in one of the present papers, consist of ordinary cores and flakes, also a number of chipped forms in the shape of hand axes, scrapers, and perforators—all apparently bearing the earmarks of human handiwork. A nearly parallel series of flints, obtained from the Bramford Pit (not far from Foxhall), are described in the same paper.

A second paper describes and figures in natural size six especially large flints found on the foreshore at Cromer. These specimens in part resemble the *coup de poing*, or hand axe type, of the Lower Paleolithic industries and are so regarded by the author. It is assumed —and doubtless properly so—that these flints were washed from the exposed Cromer Forest Bed deposits, which Moir regards as of Late Pliocene origin; while others, such as Lyell and Osborn, consider the formations as of early Pleistocene date. A third paper describes an early paleolith (a hand axe) found *in situ* in the Glacial Till bluff at Sidestrand in Norfolk. The specimen, together with its matrix, was derived, it is thought, from an older geological formation, perhaps of the same date as the Cromer Forest Bed series, which, as indicated above, contains flints of the same general character.

PLEISTOCENE MAN.—A fourth paper by Moir concerns the discovery, in a single excavation near Ipswich, of no less than five successive "occupation floors," or buried land surfaces on which ancient man camped or which he temporarily occupied. The bottommost of these "floors" contains traces of fire and of flint flakes of an indeterminate industry; the next three levels yield flints of distinctly Mousterian affinities; and the uppermost level is distinguished by specimens having Aurignacian characteristics. Above the top floor are found scattered Solutrean blades and finally, the surface soil gives implements of Neolithic type. One remarkable feature of the investigations at this site is the discovery of crude pottery (fragments) in the upper Mousterian level. The fifth and last paper describes seven flint blades of early Solutrean type, found mostly in Suffolk, at varying depths in the gravels ranging down to eighteen feet. Some of the specimens are fine examples of workmanship and, but for the depths at which they were discovered, would most naturally be regarded as of Neolithic date.

Truly, fifteen years of labor were never more amply rewarded than those of Mr. Reid Moir in his own home district! After decades of heated argument about eoliths and Tertiary man, the facts are now more or less frankly admitted by competent opinion both Continental and American. Perhaps the only embarrassing feature of the situation is the comparative indifference of English scientists.

[1]The reader is referred to the article by Prof. Henry Fairfield Osborn entitled "The Pliocene Man of Foxhall in East Anglia" that appeared in the issue of NATURAL HISTORY for November-December, 1921.

And yet, as if to contradict this statement, there comes to our desk, at the moment of writing, a booklet by J. W. Gregory, professor of geology at the University of Glasgow, entitled *Evolution of the Essex Rivers and of the Lower Thames*. This intensive study of local geological history contains a brief chapter on the geology of East Anglia with special reference to the advent of man. In the course of his remarks on this subject Professor Gregory accepts, at least in general terms, the validity of the conclusions of Mr. Moir and other East Anglian archæologists.

MIOCENE MAN.—One of the first Continental authorities to accept Mr. Moir's work was Prof. Louis Capitan of the École d'Anthropologie in Paris. Characteristically his enthusiasm has not allowed him to rest satisfied with proofs of the Pliocene antiquity of man; he now champions the long-rejected evidence for Miocene man. In a recent letter to Prof. Henry Fairfield Osborn he tells of having made new excavations last October at Puy de Boudiou, Department Cantal, France, where is situated a flint-carrying deposit of recognized Miocene date; of having studied the local geology of this as well as of the contemporary neighborhood site of Puy Courney, of long-standing fame; and finally of having examined and reëxamined all the extant collections from the two sites. "All this," he writes, "results for me and my friends who have viewed the pieces objectively that not less than forty of them present all the characters of worked flints, and well worked, recalling the Mousterian types—grattoirs, racloirs, knives, perforators—of which the flaking and retouching resemble indisputably voluntary and intelligent workmanship. This is my positive opinion; but this gives an earlier date than the known species of man or his precursors and enables one to understand the hesitation of scientists. Nevertheless, the flints are there and their stratigraphy is indisputably contemporary with *Hipparion*, *Dinotherium*, and the mastodon."—N. C. N.

THE APPROACH TO ROOSEVELT MEMORIAL HALL

Park Commissioner Francis D. Gallatin is planning the approach from the West Side drive to the Roosevelt Memorial Hall. A spacious carriage way, with broad flanking pathways, will lead directly up to the great façade. A double row of trees will line these pathways and the landscape engineer, Mr. J. V. Burgevin, agrees with President Henry Fairfield Osborn that the tree that deserves this place of honor is the *Ginkgo*, or maidenhair tree. It is a striking fact that this ancient tree, which like the cycads and the big trees of California is reminiscent of the flora of the Mesozoic, is one of the trees best able to withstand the hostile environmental conditions of New York City. In this connection we quote from the delightful work of Dukinfield Henry Scott, recently published, entitled *Extinct Plants and Problems of Evolution*:—

> The family of the Maidenhair Tree is . . . . only represented in the living Flora by a single species, *Ginkgo biloba*, a beautiful tree with leaves like magnified leaflets of the Maidenhair Fern. There is some doubt whether this species is actually known in the wild state; to a great extent it has been preserved from extinction by the piety of the Buddhists, who grow it as a sacred tree in the precincts of their temples, in China and Japan. The Maidenhair Tree is the last survivor of a group of Gymnosperms of considerable importance in long-past geological times.
>
> Then we come to the Cycads, a family little known except to botanists or travellers in warm countries. A magnificent collection of these plants will be found at Kew, chiefly in the Palm-house. . . . The Cycads often bear a superficial resemblance to Palms, and sometimes are called by the absurd name of Sago-palms; really they have nothing to do with the true Palms, and their sago is not of much account. For the most part the Cycads bear cones; they are fine handsome plants. . . . The Mesozoic Age, however, is justly called the "Era of Gymnosperms." Besides the Cycads, there were in those days very many Conifers overspreading the world, and a considerable number of Maidenhair Trees or their relations. This last group is of much interest, from the fact, already mentioned, that it is now represented by a solitary surviving species. The zenith of the Maidenhair Trees (Ginkgophyta) was attained in the Jurassic. At that period, various species are found which cannot be distinguished from the recent genus *Ginkgo*, while there were also others, with more divided leaves and some further differences, indicating distinct genera.

EXTINCT ANIMALS

FOSSIL HORSES FROM THE TEXAS PLIOCENE.—The American Museum Expedition in northern Texas has secured from the Blanco formation, Upper Pliocene, a fine skeleton representing a stage in the evolution of the horse intermediate between that of *Pliohippus* of the Lower Pliocene and that of *Equus* of the Lower Pleistocene. *Pliohippus* is the earliest of the one-toed horses. In it

the splints that represent the side toes of the earlier ancestors of the horse are almost as long as the cannon bone; in *Equus* they are about half as long. *Pliohippus* and representatives of all the earlier stages also retain a small splint or nodule of bone, the last remnant of the fifth digit of the fore foot, which is a complete toe in the Eocene horses; in *Equus* this has wholly vanished. *Pliohippus* is considerably smaller than *Equus*, its teeth are shorter, its feet more slender, and in various particulars it is more primitive,—that is, nearer to the earlier evolutionary stages. The size and proportions of the skeleton obtained from the Blanco formation are those of a rather small *Equus*, the pattern of the teeth is intermediate but nearer to *Pliohippus*, a tiny nodule of bone remains to represent the fifth digit of the fore foot, and it is expected that when the skeleton is prepared and studied, it will be found to be intermediate in many other details. The geological succession of the stages in the evolution of the horse is as follows:

One-toed horses	Lower Pleistocene	Sheridan and Rock Creek	*Equus*
	Upper Pliocene	Blanco formation	(New stage)
	Lower Pliocene	Oak Creek, Upper Snake Creek, etc.	*Pliohippus*
Three-toed horses	Upper Miocene	Pawnee Creek beds, etc.	*Merychippus*
	Lower Miocene	Harrison, Rosebud beds	*Parahippus*
	Upper Oligocene	John Day, Upper White River	*Miohippus*
	Lower Oligocene	White River. (middle and lower)	*Mesohippus*
Four-toed horses	Upper Eocene	Uinta formation	*Epihippus*
	Middle Eocene	Bridger formation	*Orohippus*
	Lower Eocene	Wasatch formation	*Eohippus*

The latest stage, *Equus*, lasted along into the middle Pleistocene in North America and then became extinct, but in the meantime *Equus* had found its way into Asia and Africa, where the type still survives in the modern horses, asses, and zebras; and the true horse, domesticated by man, was reintroduced into the New World by the Spaniards and later colonists.

The three-toed horses of the Miocene were small animals about the size of a Shetland pony. While some of them evolved into the large one-toed true horses, others, more conservative, retained their side toes and small size, developed a somewhat different pattern of teeth, and survived in the Pliocene of Texas and Florida, also finding their way into the Old World, where they were first discovered in the Pliocene of Europe and named *Hipparion*, or "little horse." It was at first thought that these Old World examples of *Hipparion* were the ancestors of the modern horses, but it now appears that they were a side branch, and the more direct line of descent is traceable through the American *Pliohippus* and the skeleton, as yet unnamed, from the Blanco formation.

A small species of *Hipparion*, hardly larger than a sheep in size, was common in the Upper Pliocene, and skulls, limbs, and feet of several individuals were found by the Museum party in the Blanco formation. More fragmentary remains were also found in the Pliocene of Florida.

It is perhaps in order to note here that in some of the recent well advertised attacks upon evolution the statement has been made that the above succession of geological formations and of stages in the evolution of the horse is arbitrarily arranged, and that there is no proof that the formations were successive and not contemporary. Such a statement is wholly untrue, and could be made only in entire ignorance or reckless disregard of the facts. It has not, of course, been made by any geologist of standing or by anyone who has any practical knowledge of the field conditions or any experience in collecting fossil mammals. The entire sequence of formations and stages is not found in any one place, but it is correlated from several partial and overlapping sections, as shown more in detail in *The Age of Mammals* and various other publications by Professor Osborn and others. The sequence of the formations is quite beyond doubt, and the evolutionary stages characteristic of each are never found in an earlier formation, although they sometimes survive into later ones without much change. In southwestern Wyoming the Wasatch formation with *Eohippus* definitely underlies the Bridger with *Orohippus*, and in northeastern Utah it underlies the Bridger and Uinta. In south-central Wyoming the Uinta definitely underlies the White River. In western South Dakota and Nebraska the upper White River underlies the Rosebud and Harrison; these underlie the later Miocene; the latter underlies the Lower Pliocene; and the Pleistocene caps the series, Upper Pliocene here being absent (or unfossiliferous so far as known). In each of these cases the identity of the stage is proven by the

presence of fossils of the appropriate stage of Equidæ, and of the various other animals the evolution of which has been traced.

The sequence in the case of the horse is merely one item out of a vast mass of evidence which proves the correctness of the geological procession as accepted by competent geologists.

A third important find made by the Museum party in the Blanco formation is a fairly complete skeleton of a fossil camel. Various fragmentary remains of larger and smaller species of horses and camels, mastodons, ground sloths, glyptodonts, peccaries, etc., will aid in the study of this interesting fauna.

The party consisted of Dr. William Diller Matthew, Mr. G. G. Simpson, and Mr. Charles Falkenbach. The friendly interest of many residents in the various localities examined aided considerably in the success of the expedition. The Museum is indebted especially to Messrs. Parke and McAdams of Clarendon, and Judge Daniels of Silverton; and the Messrs. Webb and R. B. Smith of Crosbyton, Texas, for various courtesies.—W. D. M.

Dr. George Hickling, one of the delegates to the meeting of the British Association for the Advancement of Science, stopped at the American Museum on his return journey to work on the fossil shark skulls from Texas represented in the collections of that institution. Dr. D. M. S. Watson, another delegate, spent several days in the department of vertebrate palæontology in conferences with Doctors W. D. Matthew and W. K. Gregory and with Mr. Walter Granger.

A NEW GIFT TO THE MUSEUM LIBRARY

The Library of the American Museum is again indebted to Mr. Ogden Mills for a gift of books that will be of great service to research workers visiting the institution as well as to the Museum staff. The volumes were originally part of the library of the English ornithologist, Major W. H. Mullens.

NEW MEMBERS

Since the last issue of Natural History the following persons have been elected members of the American Museum, making the total membership 7764.

Life Members: Mrs. William Belknap; Messrs. Harry Burrell, John H. Hall, Jr., Ellis Stanley Joseph, Arthur N. Milliken, and William Rennult.

Honorary Life Member: Doctor H. Schouteden.

Annual Members: Miss M. Parsons; George Clinton Andrews, M.D.; Messrs. John Burden, Alfred J. Crane, Joseph N. Early, Frank Phillips, E. C. Smith, Noel Statham, and Charles B. Williams.

Associate Members: Mesdames Preston Boyden, Richard H. Day, Emilie L. Heine, A. Howard Hinkle, Paul Jernigan, Walter Hines Page, Fry Strohl; the Misses Nellie P. Carter, G. H. Emery, Minna Frotscher Koch; Bishop Boyd Vincent; Doctors Stanley C. Ball, Samuel C. Harvey, Matthew F. Kreisle, Alfred Resch, Harris H. Vail; Henry T. Smith, D.D.S.; Prof. Alfred Rosenblatt; Messrs. J. Earle Bacon, Francis N. Balch, Thomas Alexander Barns, J. C. Basak, Edward M. Brewer, Peter Bulthouse, Clifford Coles, S. B. Gibbs, Floyd C. Hach, Rush N. Harry, Edward Murdoch James, David M. Johnson, Harper Kelley, R. T. Kellogg, Geo. K. Lehner, Thornton Lewis, James W. Lowry, William M. Matthews, Benj. L. Miller, C. O. G. Miller, Robert Watt Miller, P. M. Norton, H. Eugene Parrott, Robert Livingston Resor, Remingio Rigal, Geo. T. Ruddock, W. Kesley Schoepf, Lee W. Sexton, Wm. Short, E. B. Stanley, Jose Steinbach, George F. Sternberg, Will Sutton, W. O. Wayman, Frederick S. Webster, Robert Welles, and H. A. Worcester.

The European Number

In the successive issues of NATURAL HISTORY for 1924 the reader has been given the opportunity to make a scientific tour of the world, necessarily not exhaustive but serving to call attention nevertheless to some of the wonders of nature in Australia, Asia, South America, in the oceans and on their islands, as well as to the part that the American Museum and other institutions have had in making known the interest of our globe.

With the November-December issue a return is made to **Europe,** the birthplace of our civilization, the land of our forebears. It is the anthropological and archæological interest of that continent that will have especial emphasis in this number. Mr. J. Reid Moir, who has devoted years of conscientious study to the problem of the eoliths, will discuss the evidences of Tertiary man in England, while some supplementary remarks on the subject will be appended by Sir Ray Lankester, formerly director of the British Museum (Natural History). These essays are to be followed by a paper contributed by Dr. Louis R. Sullivan, associate curator of physical anthropology in the American Museum, devoted to the "Relationships of the Upper Palæolithic Races of Europe." The Museum has been accumulating throughout a long series of years a valuable collection of Old World archæological material, and Mr. N. C. Nelson, associate curator of archæology, who has charge of this collection, will call attention to some of its points of interest. Obermaier's recently published volume *Fossil Man in Spain*, will be reviewed by Miss Christine D. Matthew.

The papers above mentioned are actually in hand and their publication is therefore assured, but it is the hope that one or more eminent authorities, in addition to the contributors specified, may find it possible to fulfill promises tentatively made by writing articles dealing with other phases of the archæology of Europe.

The American Museum's recent expedition to Lapland, undertaken by Dr. G. Clyde Fisher and Mr. Carveth Wells, will be commemorated by a beautiful series of illustrations of Arctic flowers preceded by a brief introductory article.

Finally, the natives of the Russian Far East will be represented in a series of decorative pictures prepared under the supervision of V. K. Arsenieff.